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E. H. B.

# TRANSACTIONS

OF THE

# EPIDEMIOLOGICAL SOCIETY

OF

# LONDON.

NEW SERIES. VOL. II.

SESSION 1882–83.

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1878. Airy, Hubert, M.D., Local Government Board, Whitehall, S.W.
1882. Adams, G. D'Arcy, M.D., 1, Clifton Gardens, W.
1882. Barry, F. W., M.D., Local Government Board, Whitehall, S.W.
1883. Bovill, Edward, M.B., C.M., Surgeon Ind. Med. Dept., Messrs. H. S. King and Co., 45, Pall Mall, S.W.
1870. Buchanan, George, M.D., F.R.S., 24, Nottingham Place, W. (P. 1881-83. T. 1871-81.)
1882. Carpenter, Alfred, M.D., Duppas House, Croydon.
1883. Castor, G. F., M.B., Colonial Surgeon, Gold Coast.
1882. Cobbold, T. Spencer, M.D., F.R.S., 74, Portsdown Road, Maida Vale, W.
1876. Chevers, Norman, C.I.E., M.D., President, 32, Tavistock Road, Westbourne Park, W. (President from 1883).
1868. Cock, Fred., M.D., 1, Westbourne Park Terrace, W.
1875. Collie, Alexander, M.D., Fever Hospital, Homerton, E.
1871. Corfield, W. H., M.D., 10, Bolton Row, Mayfair, W. (S. 1871-72.)
1879. Cory, Robert, M.D., 73, Lambeth Palace Road, S.E.
1863. Crawford, Thomas, M.D., Director-General Army Med. Dept., 6, Whitehall Yard, S.W.

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* Members are requested to inform the Secretaries of any corrections when necessary.

Elected.

1863. Dickson, Walter, M.D., R.N., Fairfield, Belvedere Road, Upper Norwood.

1880. Don, W. G., M.D., Brigade-Surgeon Army Med. Dept., 6, Whitehall Yard, S.W.

1883. De Renzy, A. C. C., C.B., Surg.-Gen. Ind. Med. Dept. (*Retired*), 9, Sydenham Villas, Bray, Co. Wicklow, Ireland.

1871. Dyke, Thomas Jones, Merthyr Tydvil, South Wales.

1879. Ewart, Joseph, M.D., Dep. Surg.-Gen. Ind. Med. Dept. (*Retired*), Montpelier Hall, Brighton.

1875. Fayrer, Sir Joseph, K.C.S.I., M.D., LL.D., F.R.S., Surg.-Gen. Ind. Med. Dept. (*Retired*), 53, Wimpole Street, W. (P. 1879-81).

1882. Fleming, G. F., F.R.C.V.S., Cathcart Lodge, Tyrwhitt Road, St. John's, S.E.

1883. Furnell, M. C., M.D., Surg.-General, Madras.

1883. Furnivall, C. H., Acton, Middlesex.

1880. Gordon, C. A., C.B., M.D., Q.H.P., Surg.-Gen., 25, Westbourne Square, W.

1881. Groves, H. J. F., 320, Brixton Road, S.W.

1877. Hamilton, J. Lawrence, 34, Gloucester Terrace, Hyde Park, W.

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1860. Haward, Edwin, M.D., 9, Harley Street, W.

1882. Hobley, S. Halford, 49, Bellevue Road, Southampton.

1879. Hood, Donald, M.D., 43, Green Street, Mayfair, W.

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1880. Hunter, W. G., M.D., Surg.-Gen. Ind. Med. Dept., 21, Norfolk Crescent, W.

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1881. Kynsey, W. R., Stoke Lodge, Guildford, Surrey.

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1850. Milroy, Gavin, M.D., 9, St. John's Villas, Richmond, Surrey (P. 1864-66. S. 1862-64).

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C. 1851. Spooner, W. C., Vet. Surg., Southampton.
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C. 1860. Taylor, H. Sharp, 15, Quarry Street, Guildford.
C. 1855. Tholozan, J. Désiré, M.D., Teheran.
N.R. 1853. Todd, J. George, Evenwood, West Auckland, Durham.
N.R. 1873. Townsend, Stephen Chapman, C.B., Surg.-Gen. Ind. Med. Dept., Sanitary Commissioner for Central India.
C. 1851. Tribes, E., Nismes, France.
C. 1855. Tribuchet, Adolphe, Paris.
N.R. 1880. Tatham, John, M.D., Town Hall, Salford, Manchester.
C. 1853. Valerj, —, M.D., Rome.

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C. 1852. Varentrapp, George, M.D., Frankfort.
C. 1855. Virchow, Rudolf, Professor, 10, Schellings Strasse, Berlin.
C. 1856. Von Iffland, —, Beaufort, New Quebec.
N.R. 1879. Watson, Alexander, M.D., R.N., Dep. Insp.-Gen., Army and Navy Club.
C. 1853. Watson, John, M.D., Jamaica.
N.R. 1880. Whishaw, J. C., M.D., Surg.-Major Ind. Med. Dept., Lucknow.
N.R. 1880. White, J. Berry, M.D., Surg.-Major Ind. Med. Dept., St. Andrews House, Hertford, Herts (retired).
C. 1861. Whitelaw, Wm., M.D., Kirkintilloch, Dumbartonshire.
N.R. 1854. Wiblin, John, Southampton.
N.R. 1865. Williams, C., 9, Prince of Wales's Road, Norwich.
N.R. 1872. Woodall, John (address not known).
N.R. 1875. Wortabet, John, M.D., St. John's Hospital, Beyrout.

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## CONVERSAZIONE.

### DEMONSTRATION OF MICRO-ORGANISMS OF DISEASE.

THE thirty-second session of the Epidemiological Society was opened on October 18th, 1882, by a Conversazione held in the General Library of University College, London, at which, by the invitation of the President, DR. GEORGE BUCHANAN, F.R.S., a large number of members and friends of the Society were present.

In addition to various objects of general interest, several microscopic preparations of micro-organisms, the existence of which in different diseases has of late years so much engaged the attention of pathologists, were exhibited.

DR. SPENCER COBBOLD, F.R.S., showed some specimens of the adult *Bilharzia hæmatobia*, the cause of the endemic hæmaturia of Egypt and Natal, and demonstrated during the course of the meeting the hatching of the ova in urine recently obtained from one of his patients. The contractile movements of the embryo, by which it separated itself from, and finally ruptured, its shell, were distinctly seen, as well as the rapidity with which, after its escape from the egg, it swam about in the preparation, like a paramœcium, by the aid of its covering of cilia.

DR. E. KLEIN, F.R.S., showed and explained several preparations of *Bacillus tuberculosis*, both *in situ* in the diseased tissues of man and in the lower animals, and in the sputum of phthisical patients, and pointed out the importance of their presence in the latter, as a means, which subsequent observations have still further confirmed, of diagnosing between tuberculous phthisis and other affections of the lungs which may give rise to similar physical signs. He also showed specimens of the *Bacillus Anthracis* obtained from the splenic blood of a mouse, and from sections of the liver of a guinea-pig, in which the organisms were seen to form faggot-like agglomerations, and to block the intra-lobular capillaries. Another slide showed the development of the bacilli, in nutrient media outside the body, into long delicate filaments,

which gradually became divided by transverse partitions or septa, and presented in their interior minute rounded, or oval, highly refracting bodies, the spores. Besides specimens of the short and delicate *Bacillus of Septicæmia*, Dr. Klein also exhibited sections of the spleen and kidney from the Welbeck and Nottingham cases of ham-poisoning, referred to in Dr. Ballard's report to the medical officer of the Local Government Board 1880. Unusual interest was excited by the preparations, shown here for the first time, of micrococci in the fresh blood, and in the hepatic capillaries, from cases of infantile diarrhœa; while the radiating star-like masses of *Actinomyces*, obtained from the tongue of cattle suffering from small tumours caused by that fungus, formed remarkably beautiful objects under a moderately high power.

Dr. Stephen Mackenzie presented several microscopic specimens of colonies of micrococci in the mitral valves, from cases of ulcerative endocarditis, and in the pulmonary vessels in pyæmia, as well as embryo *Filariæ sanguinis hominis* from the Chinese mosquito, and from a patient who had been under his care a short time before the meeting. He also showed a chart of the periodic appearance and disappearance of the parasites from the blood, and the alterations produced in their migrations by changing the host's hours of rest and of activity.

At an adjacent table were placed several specimens, lent by Dr. Charlton Bastian, F.R.S., of embryos of the guinea-worm (*Filaria medinensis*), and of trichinæ in the muscles of a wild boar, an animal which had not hitherto been noticed as a host to those worms. Specimens of the micrococci in diphtheritic false membrane and in septicæmia were exbited by Dr. Heneage Gibbes, as well as some of the ring-worm fungus artificially cultivated in gelatine-peptone by Dr. G. C. Henderson, and Mr. Malcolm Morris. Among the anatomical preparations placed before the Society were some showing tuberculosis, the result of feeding animals with infected meat; and the stomach of a calf infested with *Strongylus contortus*, lent by Professor Axe. Professor De Chaumont, and Dr. Boileau, also sent preparations exhibiting the lesions of dysentery and of enteric fever as met with in India, and of the affection known as the "Madura foot."

Great interest was also taken in the different models and plans of temporary and permanent hospitals for infectious diseases, of disinfecting apparatus and yards, etc. And the meeting separated at a late hour.

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# A GLANCE AT THE SANITARY DEFECTS OF THE SITE OF LONDON AND ITS ENVIRONS.

By NORMAN CHEVERS, C.I.E., M.D.

(*Read: November 1st*, 1882.)

It is probable that the sanitarians of the future will declare that we, the sanitary pioneers of the nineteenth century, were little more than unclean barbarians, unable to master the first principles of scavenging, when they read that, despite all our affectation of learned dogmatism, and our pretence that our rude art is an exact science, a preventable fever took from our midst the best-beloved man of his time; that the same malady well-nigh deprived Britain's loyalty of its dearest hope; that our oldest and newest palaces are not more free from diphtheria and puerperal fever than the swamp-engirt towers of the Middle Ages were from black death and sweating sickness; and that when a ruler, as honoured in Europe as he was valued and revered in his own great republic, lay for weeks between life and death, his danger was rather from the marsh poison which environed his palace, than from the wound, which nature, aided by a pure and cool atmosphere, might possibly have repaired.

Among the few not unquestionable advantages enjoyed by the Indian physician, in his European retirement, is the power of viewing the sanitary condition of his surroundings by the light of Indian experience. Although not generally himself "plentiful in the possession of dirt", he has learnt to become an accomplished critic in all that concerns the dirt of others. He knows that, but for the influence of marsh poison and accumulated city and village filth, even the plains of India would afford healthy dwelling-places for Europeans. He observes that, in like manner, notwithstanding all that modern land and town drainage has effected in the way of improvement, the most prevalent and worst diseases of the United Kingdom are due to the survival until to-day—may we not say to the permanence?—of thousands of acres of unreclaimed marsh land, still deserving of its ancient names

of slough and swamp, and to the presence of thousands of miles of sewers, drains, and ditches—mere elongated cesspools—which retain, exhale, and exude well-nigh as much as they void. Having taken some active part in the difficult task of introducing a sanitary system in Eastern cities and cantonments, he, on his return to London, puts to himself the question which I shall venture to propose to you—*How far were two small hills, almost surrounded by morasses, chosen by a few hundred Celtic warriors as an almost unapproachable stronghold, calculated to become the centre of a salubrious residence for four millions of civilised people?*

An otherwise rather well-informed writer tells us that "the spot on which London is built, or at least that on which the first buildings were most probably erected" [the neighbourhood of St. Paul's Cathedral], "was pointed out by nature for the site of a city". Yes, we reply, as the vantage-ground of a Roman cohort and its followers, at a time when military sanitation was in its infancy, and the health of a few Gaulish or Celtic legionaries was not highly valued; but a locality no more fit or likely to be chosen in the present day, by sanitarians, as the central site of an enormous royal city, than the mud-banks of Venice, the Goodwin Sands, or the Eddystone rock.

Still, according to their lights, the Celtic and Roman leaders chose their position wisely. Here the Britons, who were very little, if at all, removed from the lacustrines, advanced their wooden dwellings on piles from the margin of the estuary, taking plenty of "fat and sweet salmon", as Stow calls them, in the stream; relying on the forests at their rear for timber, firewood, venison, and wild boar's flesh, and on the swamps for wild fowl; and having the double scarped hill and the great trackless fen to retire to if driven back from the river. The Romans availed themselves of the Britons' earthwork and walled it round. They had the great advantages of a well-raised site and of that still-lauded building platform, "a dry gravel soil".

If one had told Lucius Londinensis, the prætor, that his successors, in the Middle Ages, would extend the city over the muddy bed of Wapping-in-the-Wose and the quagmire of Fensbury, he would have replied scornfully, "We Romans do not build on water! We leave that work to the painted Britons on the strand below, who are our fishermen, and to my colony of beavers yonder on the Old Bourne. See, they have thrown a dam across the torrent, thus commanding the approach to the Western Mount!" The execution (shall we

say perpetration ?) of these feats in architectural progress was left, not to the skill and enlightenment, but to the cunning and greed of the "jerry builders" who have flourished in London since the reign of Elizabeth.

The Celtic and Roman founders of London knew nothing either of the laws of malaria or of the existence of sea-coal, otherwise it might have occurred to them that slight elevations above swamps are peculiarly exposed to pestilential visitation, and that the fogs of the London basin collect smoke, develop "smuts", and thus kill many. In short, the site of London was chosen by barbarians, mainly because it was defensible in war, and we civilised people have continued to hold it, despite all its drawbacks, with the stolid tenacity of a race who do not know when they are beaten.

Even in addressing you, Sir, I may perhaps be allowed, for the sake of the continuity of my argument, to give a very slight outline sketch of the topography of ancient and modern London. Roughly speaking, its superficial geology may be represented by an oval cup of London clay and brick-earth, extensively traversed and margined by marsh alluvium, across the longest diameter of which irregular heaps of more or less sandy gravel form a broken line of slight elevation. Here the clay and the marsh-mud stretch widely; the gravelly sand is by no means abundant. If the latter had happened to be chalk—not silex—we might be pardoned for saying that the complaining tenants of the jerry builders have no firm ground to stand on, unless they assert that far more sack than lime is apportioned to them.

He who travels from Ludgate Hill to Aldgate, and again from Moorgate Station to London Bridge, will have traversed the whole length and breadth of Roman London. If we annex to this area Westminster (then within a narrow compass), Fleet Street, Whitefriars, and Holborn (the northern part of the latter being sparsely built), and suburbs at Clerkenwell, north of Aldersgate and Bishopsgate, at Aldgate and to its north, and eastward of the Tower, we have then the London of Charles II, in which the Plague and Fire gave us sanitarians several grimly demonstrative lessons. Few of London's outer suburbs existed, except as village greens, until within the memory of some whom I now address.

As I have already hinted, the greater part of Roman London was seated on good building ground. It must have suffered from the marish vapours of its surroundings, but it is probable that there was little natural uncleanliness in the

stream of Wallbrook, which rose in the swamps of Fensbury and Moorfields, and passing near the site of the Mansion House to the Thames, at a depth of some thirty feet below the present surface-level, divided the Western Hill—site of the (doubtful) Temple of Diana and of St. Paul's—from the Eastern Hill, above Billingsgate; but, also between these hills, there was a swampy locality, of which Stow tells us, "Fenchurch Street took that name of a fenny or moorish ground, so made by means of this bourne" [Langbourn], "which passed through it, and therefore, until this day, in the Guildhall of this city, that ward is called by the name of Langbourne or Fennieabout".

It will be recollected that the remains of Roman London generally lie from fifteen to seventeen feet, and here and there to about twice the latter depth, below the present surface. One who, having turned into a narrow passage—Pannier Alley—near St. Paul's, will read, upon a stone there, the inscription—

"WHEN Y^E HAVE SOVGHT
THE CITY ROVND,
YET STILL THIS IS
THE HIGHEST GROVND",

and will then drive straight to Bow, will observe that there is an extremely moderate and *facilis descensus* from London's highest peak to the Essex marshes. Originally, marshes or swampy soil surrounded the entire land aspect of modern London, with the exception of an isthmus on the north-west, traversed by Watling Street, the Roman road from Westminster to Verulamium, nearly in the line of the present Edgware Road.

*North.*—The whole line of the northern hills had, at its foot, what in India is called a *terai* of jungly, oozy soil, into which the drainage of the uplands sank, to be only partially carried off by streams, of which the Fleet, Tybourne, and Westbourne were chief. The very name of Holloway is sufficiently expressive. We are told* that the soil in this part being a stiff clay, that portion of the road from Highgate to Islington which passes through Holloway was, in the time of Henry the Eighth, made with gravel excavated on the top of Highgate Hill by an amiable hermit who had taken up his abode there. "A two-handed charity," says Fuller, "providing water on the hill where it was wanted, and cleanness in the valley, which before, especially in winter, was passed with great difficulty." Considerably southward of this there was an oozy hollow, now traversed

* Walford's *London.*

by the Underground Railway, a portion of which was known, early in last century, as "Bagnigge Marsh". Immediately to its north, the city was protected, and impested, outside Cripplegate Postern and Moorgate, by Fensbury and Moorfields, described by Fitzstephen [*temp.* Hen. II] as "the great fen or moor (*palus illa magna*) which watereth the walls of the City on the north side". Of this vast swamp, Howes says:—"This field, untill the third year of King James, was a most noysome, offensive place, being a generall laystall, a rotten morish ground whereof it first tooke the name. This fielde for many yeares was burrowed and crossed with deep stinking ditches and noysome common shewers, and was of former times held impossible to be reformed." Up to the year 1800, much of Southampton Fields, where the Field of the Forty Footsteps was, north of the British Museum, was scarcely in a better condition.

*Eastward.*—London is immediately bordered by the very extensive marshes of the River Lea and the Thames—Tottenham Marsh, Walthamstow Marsh, Low Leyton Marsh, Hackney Marsh, West Ham Abbey Marsh, Plaistow Marsh, and Bromley Marsh. There was river wall, excluding the stream from the Marsh, up to Poplar and Blackwall. This pre-historic barrier was broken at Wapping (the river front of Stepney), which was, originally, a great wash or swamp, first recovered in the reign of Elizabeth. It is called by Stow, "Wapping in the Wose", "signifying", says Strype, who was a Stepney man, "as in the wash or in the drain". Then there is the Isle of Dogs, which I recollect as a vast, desolate marsh in which cattle grazed, immediately opposite Greenwich Palace. Peter Cunningham says that, in 1830, it was nearly uninhabited. Chatelain's print of the London Hospital, published soon after it was erected in 1740, represents it as standing in a water meadow, with a great ditch in front of it, and with a gigantic rubbish-heap called the Mount, where the plague-pit for the East of London was, close on its western side. East of the marshes which I have named are the vast tracts of Essex and Kentish Marshes, extending sixty miles to the sea. Who has not felt what a modern novelist describes as "the bitter blast, the rasping wind, blowing up the river from Plumstead and Woolwich, and all the chilly eastern marshes", in "its biting power"?

*Southward.*—Christopher Wren certainly had grounds for holding that what is now the southern bank of the Thames, opposite to London, was formerly covered by the waters of the estuary, up to Camberwell Hill. Here it may be said that the

Kentish marshes extend, with slight breaks, up to Battersea, and beyond it; Plumstead Marsh, Greenwich Marsh, Bugsby's Marsh, the low-lying part of New Cross, the great stretch of marshy ground, lately market-gardens, now becoming closely built town, westward of Deptford, up the Greenwich railway line; Rotherhithe Marsh and fields; Horselydown and Bermondsey, the seat of a great abbey founded in 1082, in the midst of a marsh. Cunningham says that this low-lying parish was long famous for its mill-streams, since converted into open ditches and sewers, covered and filled in as recently as 1849, when the ravages of the cholera rendered their removal absolutely necessary. I can hardly credit my memory when I recollect the marvellous squalor of much of old Bermondsey and Rotherhithe, and their hideous water-courses. The description of Folly Ditch, in the fiftieth chapter of *Oliver Twist*, and the prints in Wilkinson's *Londiniana* and Walford's *London*, striking as they are, are quite inadequate to realise their atrocious filthiness and utter sanitary abandonment. Let us trust that, thanks, Sir, to your predecessors and to yourself, nothing approaching to the condition of this plague-spot can ever again be seen in England—out of a nightmare. There is a slight elevation, occupied by the Romans, at old Southwark, which was aguish in Akenside's time; and then again clear marsh—Bankside, Paris Gardens, St. George's Fields. Gerard says, in his *Herbal*, "Of water-violets I have not found such plenty in any one place as in the water ditches adjoining to St. George his Fielde, near London." Lambeth Marsh: In this vicinity dysentery occurred within my own recollection. The spot on which the Victoria Theatre was built was such a quagmire that it had to be made firm by throwing in much of the rubble of the Old Savoy Palace. At a meeting of the South London Medical Society, held in 1847, there was a discussion upon a paper by Mr. Hicks on "Malaria, with Cases illustrative of its Existence on the Surrey Side of the River". Dr. Thomas Addison said that, in Southwark, London, and its vicinity, "there are decided proofs of the malarial influence. Ague is not rare, enlargements of the spleen are often met with in this neighbourhood and in Westminster. We do not, however, have ague alone, but forms of disease illustrative of its effects, as remittent fever, dysenteric and visceral derangements, many cases of which have been admitted to Guy's Hospital during the late autumn. All the cases in which the miasmatic character prevails are curable by quinine."* The river face of that now delightful spot, Battersea Park,

* *London Medical Gazette*, vol. xxxix, for 1847, p. 123.

was, until 1852, one of London's worst marshes. Battersea Fields, which it occupies, has been lately described* as having been a miserable swamp, said to have been obtained for the parish of Battersea by the act of charitably burying a drowned man there who had been refused sepulture in the adjoining parish.

Originally, the marshes *Westward*, up the river, must have been nearly as injurious to public health as those to the east. The Abbey and Palace of Westminster stand upon what was Thorney Island. The lower buildings of the Palace used to be flooded at very high tides, before the embankment was made, as Bankside, Southwark, and Lambeth Palace have been in recent times. We have record of these two occurrences, standing nearly six centuries apart. In 1235, the Thames rose so high at Westminster that the lawyers were brought out of the Hall in boats; and in October 1811 the houses in Palace Yard and Westminster Hall were flooded. Tothill Fields must have been originally a marsh. I have the large view of London, looking down the river, taken by Hollar subsequently to the building of the present St. Paul's. It shows Peterborough House, on Millbank, near the Horse-ferry, which was, in Pennant's time, "the last dwelling in Westminster" up the river. Strype says that "its situation is but bleak in the winter, and not over healthful, as being so near the low meadows on the south and west parts". My friend Dr. Duka attended an inhabitant of Millbank, whom he found to have an immense spleen and to be in an advanced state of malarious cachexia. An old chronicle describes the site of Westminster proper, where, a very few years ago, the Premier was reported to be suffering from aguish symptoms, as "a thorny island and terrible desert". Up to 1750, the only road to the Houses of Parliament was through King Street and Union Street, "which", says Smith, in his *Westminster*, "were in so miserable a state that faggots were thrown into the ruts on the days on which the King went to Parliament, to render the passage of the State Coach more easy". From Whitehall to Millbank the soil of Westminster is alluvial—true marsh. Peter Cunningham says that "a very large part of Westminster is still below the high-water tide of the Thames. Westminster was almost an island even in Elizabeth's reign. Stow writes that Long Ditch was "so called for that the same almost insulateth the City of Westminster". Of this place Strype says, "passing by this house" (Lord Jefferies') "on the same side, beginneth a short street called Delahay Street" (this

* *The Saturday Half-holiday Guide.*

sounds very like De-la-*eye* Street), "which falleth into Long Ditch which almost encompasseth this part of Westminster, now all dryed up and converted into streets and houses; a place of no great account for houses or inhabitants". St. James's Park is described as having been "a marshy waste drained and improved by Henry VIII". Up to 1682, at least, it was liable to become completely flooded. Here was a leper-house, now St. James's Palace. In 1847, Dr. Thomas Addison spoke very strongly of "the unhealthy situation of Buckingham Palace, as showing the little attention paid by the Legislature to matters so important to the public health".*

Peter Cunningham (who, if still alive, would not be an extremely aged man) wrote that it seemed but the other day since he played at cricket in the Five Fields, or pulled bulrushes in the "cuts" of the Willow Walk in Pimlico—originally called *La Neyte*—which was wholly uninhabited before 1626. At the present moment it is reported that South Belgravia is threatened with inundation from the Thames, endangering "life as well as property". Early in her married life Mrs. Somerville resided near Chelsea Hospital, hard by the embouchure of the Westbourne, now the Ranelagh Sewer, and suffered much from the dampness of the locality. Northward of this we come upon more or less elevated ground—West Brompton, Campden Hill, Notting Hill, Bayswater. Here we have some gravel, as at Kensington Gravel Pits, near and about the Palace, Gloucester Road, Brompton Cemetery, etc., and more clay, as in the great district which, in my own recollection, was the Bayswater Hippodrome, an admirably laid-out race-course, the soil of which was composed of such adhesive clay that, whenever rain fell, the horses could not run.

Such clay has been found to have its uses. In certain of the suburbs of London the clay has been, and is still being, excavated by the brick-makers, whose burnings give a flavour to the atmosphere which very nearly resembles that diffused in Calcutta from the great Nimtollah burning-ghaut for Hindoo corpses before we Justices reformed it. Then the hollows were filled in—upon the invitation "*Rubbish shot here*"—by—WHAT? and then the bricks became houses. To us moderns, who are doomed to fight for existence upon an artificial surface composed of we know not what, save that none of us are so enthusiastic as to exclaim of it, "This is my own, my native land!" it is a sad reflection that this

* *Med. Gaz.*, vol. xxxix, p. 123.

process of "land-grabbing" has probably been going on, more or less actively, for some eighteen hundred years.

A writer who evidently looked below the surface of this question, but who, doubtless, did not inhabit a Roman brick-field,* tells us that it is probable that Roman London "was principally built, like our modern metropolis, not of stone, but of brick—the convenient material which nature offered then, as it does still, in unlimited abundance on the spot, so that the most extensive ranges of architecture might be actually reared, almost like plantations, out of the very ground where they stood." A delightful piece of speculative philosophy this—for architects!

I will take a very few examples (which are intentionally far-fetched), out of hundreds which might be cited, of this London practice of building houses upon ground unnamed in the science of geology, "made" anyhow. Stow tells us that, when the Duke of Somerset destroyed the charnel-house of St. Paul's in 1549, more than one thousand cartloads of bones were deposited in Finsbury Field. On these bones "the soilage of the City" was laid, and three windmills "in a short space after raised". This locality has been densely built upon for centuries. Fifty-five years ago, the soil obtained in excavating the twenty-four acres of St. Katherine's Docks was employed in filling up the reservoirs of the Chelsea Waterworks Company; and, upon the area so formed, much of the south side of Pimlico was erected. Here was a pretty playground for the Bluecoat School! Stow says that the "Town ditch" "being there made of two hundred feet broad, was long carefully cleansed and maintained", . . . . . "but now, of late neglected, and forced either to a very narrow, and the same a filthy channel, or altogether stopped up for gardens, planted, and houses built thereon."

It has been observed by antiquarians that a little attention to the ancient place-names of London affords us a considerable insight into the original state of the land, as marshy or otherwise, which is now town. I need hardly say that *Ait*, or *Eyot*, or *Eye*, is still a common Anglo-Saxon word, signifying a small island in a river or a moderate rising in a marsh. We have an Ait at Chiswick; the old name of Pimlico was La Neyte; and, as I write this, a doubt exists as to whether the Brentford Eyot, which is described as "a waste of two acres, containing some good forest trees", shall be left to be washed away by the river, or be maintained as one of our open spaces. Wherever, in England, *eye* or *ey* enters into an ancient place-name, some expectation may

* "The Roman Remains."—Knight's *London*.

be formed of tracing the island, or the rising ground in the marsh. Thus we have the I. of Wight, as it is often written, Ireland's Eye, Eye, and Ely, Lea, Leigh, Lee, Leyton, Pevensey, Tilbury, Eton, Chertsey, and a multitude of others. These *Eyes* are only too abundant in and around London. If it were not so serious a matter, one might say that London is as full of eyes as a peacock's tail, and argue that, in the vernacular of the district, Highgate is *Eye*-gate, or the entrance to the place of *Eyes*.

Thus we have the Ty-bourne (which was also known as the Eye-bourne), Bloomsbury (originally Lomesbury), Fensbury, Fenny-about, Lothbury (probably an *eye* of the Langbourne), Aldermanbury and Bucklersbury (doubtless *eyes* of the Wallbrook), Hackney, Bromley, Stebeney (Stepney), Bermondsey, Horselydown, St. Mary Overies, Battersea (originally Patrick's-ey), Isleworth, Putney, Chelsea, Thorney. Then we have the allied word *hithe*, a bank, still annexed to the names of many places on the prehistoric river-wall of Thames—as at Greenhithe, Erith, Rotherhithe, Lambeth (Lamb-hithe), Garlic-hithe, Queenhithe. It seems to remain for sanitarians to explain the obscure ancient proverb, "If London bridge had fewer eyes it would see better."

Although I have occupied a long time in showing that—(1) *the Site of large portions of London is bad because it is marshy*, it ought not to take a great deal of argument to prove that much of the remainder of its area *is insalubrious because it is old.* Every sanitarian knows that no town, palace, or castle, which has been occupied for centuries by man and the lower animals, can possibly be a healthy place of residence. If we could trace out completely the sanitary history of each of the hundreds of nobly picturesque ruins of great houses in the United Kingdom, we should probably find that nearly all became deserted, not because they fell into hopeless decay or into Chancery, but because, after long endurance, it was determined that people could not exist in them. Hence the now generally accepted truth that many of the prettiest ancient villages, full of quaint buildings, thoroughly perflated by the fresh air of heaths and fields, and sweet with the odour of flowers, are notorious hotbeds of diphtheria and enteric fever. Hence probably the fact that, formerly, no Great Mogul would inhabit his father's palace, or even his city. Consequently, the marvellous display of deserted and ruined palaces, each surrounded by its own desolated city, which covers the Plain of Delhi.

Considering the nature of our present water-supply, it is useless now to rake up the grim history of the nitrogenous

wells of old London. Still, when I read that the Portuguese ladies who accompanied Queen Catherine of Braganza to London complained bitterly of the drinking-water, I could not but recollect the misery which, as a boy and lad, I suffered, between 1831 and 1835, in drinking the saltpetrey water, which was all that I could obtain in Southwark and in the neighbourhood of the Strand. Every reader of history knows that, early in the seventeenth century, all England was excited almost to rebellion by the inquisitions and dilapidations of the "Saltpetre Man", whom Government employed to obtain nitre for their gunpowder manufactories by digging up the floors of stables and slaughter-houses, and even of private dwellings. The black, greasy, fœtid subsoil of Old London must have afforded an almost inexhaustible mine for the Saltpetre Man, and it is now almost to be regretted that he did not succeed in carting it away bodily. Snow's Fields, upon which Guy's Hospital was built in 1773, were probably almost open fields when the house was erected, although the site was part of that Southwark which the Romans occupied. Some forty years ago, a deep trench, for a culvert, was cut from the main building down to the Southern gate in Union-street. The clay which came out of this had the appearance of an equal mixture of soot and lard, and stank abominably. I wondered how people could have brought themselves to build a hospital on such soil, until, a few years since, an accident led me to discover some cartloads of even worse filth below the very basement rooms of my own hospital in Calcutta; a modern building erected on the site of an old tank, filled with—WHAT?

Stepney may be taken as a fair example of the sanitary history of a London *eye*. Until far on in last century, Stepney proper (Stepney Green) appears to have been nearly in the condition of the many pleasant "Greens" which environed London; but it is to be borne in mind that Stepney parish formerly included the other large low-lying parishes of Spitalfields, Bethnal Green, Whitechapel, Shadwell, Poplar, and Limehouse. We read that, in the first year of Charles the First, Stepney lost 2,978 persons by the plague; and that, in 1665, plague again appeared there, and, according to the parish clerk's account, swept off 6,583 persons, besides 116 sextons and gravediggers. It is stated, in the *Life of Lord Clarendon*, that "the plague had swept away so many seamen (Stepney and the places adjacent, which were their common habitation, being almost depopulated) that there seemed to be an impossibility to procure sailors to set out the fleet." Stepney lost a character for

salubrity, which it had somehow obtained, when, in 1844 and 1866, many cases of cholera occurred in its neighbourhood.*

I have space only for a few facts showing the great prevalence, in old times, of Intermittent Fever and Dysentery, true paludal diseases, in London. We are told† that "dysentery, the disease of camps, and of those who live as if in camps, carried off its thousands annually in the crowded and dirty parts of Old London". Dysentery appeared in the bills of mortality under the name of "bloody flux". Sir Joseph Fayrer‡ says that "the Plague of London of 1665 was followed in the autumn of 1666 by an epidemic of dysentery, which was infectious, and was considered to have been due to contamination of the air by the plague victims buried in and about London the previous year; and that other epidemics of dysentery visited London in 1669-72, in 1762, and 1768." One of the *Opuscula* of Sir George Baker, published in 1763, treated "*De Catarrho et de Dysenteria Londinensis.*" In his excellent "Address on the Sanitary Condition of Laws of Mediæval and Modern London",§ Dr. Tripe shows, from an analysis of the Bills of Mortality, that, in the twenty years 1611-20 and 1631-40, which included one period during which Plague was rife, and another in which it caused only a few deaths, the percentage of deaths (plague excepted) from bloody flux was 4.2 per cent.

With regard to Intermittent Fever, Dr. Tripe shows that, during those periods, the percentage of deaths from ague and fever was so high as 12.9 per cent., or with "purples" (maculated typhus) and spotted fever added, 13.9 per cent.

In this (the seventeenth) century, outbreaks of plague, intermittent fever, and dysentery, occurred in London with irregular alternation. Sydenham tells us that, in 1661, the autumnal intermittents which, during the last few years, had been gaining ground, broke out afresh about the beginning of July. They gathered strength daily. By the month of August they were doing fearful mischief. In many places the mortality was excessive, and whole families fell victims. The form was an ill-conditioned tertian. Intermittent continued to be frequent in London until about the time of the appearance, in 1665, of the great and last outbreak of plague. Sydenham says, that for thirteen years subsequent to this, intermittents attacked only a few patients sporadically. The plague of 1665 was followed, in 1666, by dysentery. Syden-

* *The Mirror*, and Walford's *London*.
† Knight's *London*: "The Bills of Mortality."
‡ *Tropical Dysentery and Chronic Diarrhœa*, p. 5.
§ *Medical Times and Gazette*, November 12th, 1882.

ham has left us an account of the London dysentery of part of 1669, and of the whole of 1670, 1671, and 1672. He tells us that, by the end of the summer of 1668 and at the beginning of autumn, intermittent fevers were pre-eminently prevalent, so much so as to exclude all other disease from the name of epidemic. A hint of the prevalence of this disease some years later is given by a quack advertisement of 1680, which has been preserved—"The certain cure of Agues of all sorts is performed by a physitian of known integrity; they who desire his assistance may repair to his house, which is the first floor on the right hand in Gun Yard, in Houndsditch. His hours are from eight in the morning till two in the afternoon." Dr. Handfield Jones's remarks on "neurolytic and aguish disorders in London" are evidence of the fact, recognised by the whole profession, that the masked forms and hybrids of paludal disease are still rife amongst us. At page 25 of his admirable Croonian Lectures on the *Climate and Fevers of India*, Sir Joseph Fayrer has cited a figured statement which shows that the number of intermittent fever admissions and deaths at the London Hospital has diminished within the last 110 years. I do not, however, consider these data germane to our present question, seeing that the statistics of in-patients of a hospital do not, or at all events need not, represent the prevalence of intermittent in its district. Hundreds of cases of intermittent occur every day in Calcutta; but I believe that the tabular records will show that, during my fifteen years' incumbency, very few cases indeed of this disease were admitted to my wards. I purposely excluded them, our means of treating uncomplicated intermittent outside being quite efficient. It is, however, noteworthy that, in 1880, no less than fourteen cases of intermittent fever were received into the wards of the London Hospital.

Having endeavoured to prove that nearly the whole of old London is bad, from a sanitary point of view, chiefly because it is old, and thoroughly and hopelessly saturated with the filth of ages; and that nearly all its new suburbs are bad, because they are situated on marshy or clayey soil, or "made ground", or on ground which has, at some time or other, been scalped by brickmakers,* I may probably be asked, "To what practically useful ends do your observations tend?" "We cannot give up London; what are we to do with it? Would

* It would be interesting to inquire, "What has become of much of the gravel with which nature gifted London and its suburbs?" I think that there are reasons for believing that the City hills were deeply hollowed by the Celts. I know an old-fashioned garden near Calcutta, the gravel walks of which came [from London?] as ballast.

you have us condemn and desert it, as the ancient rulers of Bengal did, late in the seventeenth century, when pestilence, caused by the permanent drying up of their river, ravaged that magnificent imperial city Gour; and as the modern authorities in that country have frequently done when their military cantonments proved beyond remedy unhealthy?" My reply is, "You might do worse; but, as matters stand, a vast deal in the way of improvement has been long in progress, and much more, in the same direction, remains to be done." Ought there not to be a law preventing the erection of dwelling-houses in a marsh, each with two feet of water in its basement, which anyone may occupy who dares, or is compelled by poverty to do so? I do not know that, in the absence of such a law, those who build such houses are altogether culpable. Englishmen have always delighted to build in and near marshes, evidently preferring them to higher ground. Examine the sites of the Royal Palaces of the Tower, the Savoy, Somerset House, Whitehall, Westminster, St. James's, Greenwich, Windsor—all so directly facing extensive marshes that it might be imagined that swamps were as essential to their comfort and magnificence as gardens, chases, and pleasaunces. It is below the dignity of Britons to fear marshes; we probably inherit much of the beaver blood of our lacustrine sires, who adhered so closely to their pre-historic habits up to the middle of last century, that they maintained a street of houses on London Bridge. Some of those present may recollect that the Port of London, with its ranges of wharves supported on wooden piles, and girt together with enormous timbers, had formerly much the aspect of a lacustrine city. The delineation of the waterside dwelling of Mr. Quilp, as left to us by Dickens and "Phiz", displays the true natural history of the modern lacustrine—that worthy was undoubtedly lacustrine. He would scarcely have hesitated to build a house in a marsh, and perhaps even to lodge in it himself, if he failed to let it. But I think that it may now be time to drop these barbarisms.

Again, it may be asked, "Do you deny that marsh land can be so thoroughly reclaimed as to be rendered fit for human habitation?" This is assuredly my belief; but, although all our inhabited marshes cannot now be abandoned, it is clear that the medical men and landlords in such localities ought never to forget that their patients and tenants are thus situated and imperilled, and that the authorities must never lose sight of the special necessity of perfecting the subsoil drainage.

The typical Englishman displays almost as much alacrity

and skill as the Dutchman in depriving water of its land, but he is far less enterprising and successful in freeing the land thus reclaimed from its superfluous water, although he must know that, in doing so, he would make his property more valuable and consult his own and his neighbours' health. The time has surely come at which the thorough reclamation and utilisation of our vast marsh lands should be made the subject of a great national movement; a Royal Commission being appointed to inquire into the whole question, and adequate funds being raised. I believe that, at present, the marshes east of London are almost wholly given up as grazing ground for oxen—"beasteses", in the local vernacular. As an ex-Inspector-General of Gaols, I can perceive no objection to the employment of convicts in the work of improving the marshes nearest to London. Properly housed inland, the prisoners would not be unhealthy, nearly all the danger of marshes being to those who sleep there, and to those whom (as happens to the denizens of London) their exhalations reach at night. It is unquestionable that, with an adequate expenditure of money and labour, the improved lands would be not only more salubrious, but more valuably productive, than they are at present. I believe that, at an outlay not larger than that which many country towns have devoted to their water-supply and drainage, London might place between its dwellings and the Essex and Kentish marshes a growth of trees which would almost immediately protect it against the marsh influence in that direction, and would, in the course of a few years, considerably mitigate the severity of the east wind. It is reported that, very lately, 93,000 acres in Kansas have been set with young trees. Is a similar undertaking beyond the resources of London?

It appears singular that these two lines of marshes, having long been traversed by railway-lines, should now lie as desolate and unimproved as they were under the Heptarchy—nay, probably far more so, as the isolated position of their very ancient churches indicates. Do the Railway Authorities sufficiently consult their own interests in this matter? Surely they ought to be daily taking large bodies of labourers up and down, and to be bringing hundreds of tons of marsh produce to the London market. In establishing the Canning Town Fish and Vegetable Market, the Great Eastern Railway Company appear to have made a good beginning.

In those flats, almost unlimited space and water-supply are afforded for the construction of docks, for the reception of ships in ordinary, and for the repair and sale of vessels

of every description; for butcheries, tanneries, and knackeries; for lime-burning and brick-making in those localities where chalk and clay abut upon the marsh; for a hundred kinds of manufactories, where night service is not required; for cemeteries, crematories, and patent manure works; for ropewalks; market gardens for vegetables and fruit; for flower and seed and bulb nurseries, and lavender-beds and sunflower-fields; for reed and osier beds and lines of willows and poplars; for skating-fields, preserves for wild and tame water-fowl, and for reservoirs containing fish for market. I used to spend hours beside a pond in Essex, which, in an area of about a quarter of an acre, contained thousands of gold fish, which the thieves, who used now and then to come down from London at night and take away a cart-load, probably knew to be of great value.

Each of these establishments should have a fine sheet of water on either side, the excavated earth being used in heightening the dry area. All utterly useless parts of the marshes, if there be any, ought to be permanently flooded. In course of time, any amount of sound earth might be brought into these settlements, by tram, from the mainland; and upon the new soil, duly manured with the sewage matter of London, nearly everything that grows in England would flourish luxuriantly; just as, in India, I have seen clean-washed river sand converted, by manuring, in five years, into productive vegetable gardens. These, and very many other works of reclamation and improvement having been effected, abundance of pasture-land would remain for the development of grass culture and the fattening of beeves. Why, with unlimited land, and unbounded water and manure supply, and with railway lines traversing their whole extent, English enterprise allows these vast tracts of land, extending up to the very suburbs of London, to continue wholly unimproved, with their best qualities of reception and production undeveloped, while at the same time their exhalations poison every breath of air which the Royal City draws, stamping the typical London visage with a livid whiteness, and aggravating (if they do not actually cause it) every disease from which four millions of Londoners suffer,—why, I say, this is allowed to happen, is a fact the explanation of which is quite beyond my comprehension. The owners of marshes will, of course, say, "Our corn and potato fields extend to the margin of our marsh-lands. We would have done what you suggest long ago had we been able to meet the first outlay. In these times farmers cannot look for a return upon money expended upon land." I should be glad

to be able to reply, "The city which your marshes impest will aid you in effecting that which will be a valid work of national improvement, and which will speedily repay the needful outlay by doubling the value of your lands, and by giving us citizens the benefit of a pure sea-breeze."

I speak of these marshes with experience; I was born on a Kentish "Hithe", and much of my later youth was passed close upon the Essex marshes. It may be thought that I am prejudiced against these fens. Hear what a writer of great power said,* last summer, of the Hundred of Hoo, across which fourteen miles of railway lines have recently been opened:—"About October, the 'Marsh King's Daughter,' the subtle, deadly ague, wanders over the wild flats and pale waters, and one may catch malarious fever as easily as a cold in the Hundred of Hoo. In the infrequent shepherds' cottages, which break the utter solitude, quinine and Gregory's powder are brought from market as regularly as tea and sugar; the marsh people would not understand existence without 'shivers' and 'spleen cake'. Ague is part of their ordinary life."†

I think that there is utility in these reflections, if it lie only in the practical facts that it is needful that the public should be made aware that he who, on first occupying a swamp, builds upon an *eye*, or near it, hardly fares better, as regards his sanitary position, than he who drives piles into the ooze and erects his cabin there; and that it is well worth the while of every sensible man whose property or residence is upon an *eye*, whether the locality be of ancient or recent occupation, to look vigilantly about him, to ascertain whether there is, or has been, a surrounding marsh; and, if this be the case, to have recourse to those remedial measures which are dictated by sanitary science and by the law of the land.

Every landlord ought to be under legal obligation to satisfy his tenant, whether the site of his house has been a marsh, a pond, a brickfield, a laystall, a burial-ground, or a

* Leader in *The Daily Telegraph.*

† There is great truth in the observation of John Martin, the artist, cited by Cunningham from the *Thames and Metropolis Improvement Plan*, page 20:—"The unwholesome fogs that prevail around London originate in the lamentably defective drainage of the neighbouring lands, as the numerous stagnant pools, open ditches, and undrained marshes in the East, and cold clay lands along the banks of the Thames, Colne, Lea, Wandle, etc. When these spots are thoroughly drained, the fogs will cease, and London become the most healthy city in the world." I can recollect that, in Martin's time, London fogs were considerably less dense than they now are. Then the smoke nuisance made them yellow; its vast increase now renders them black.

plague-pit, or is saturated with the filth of ages; whether "rubbish has been shot there", and whether boring shows that rubbish to have been clean or unclean; whether the building stands upon a sufficient layer of concrete, and whether there are disused cesspools or drains in or near the basement. Indeed, I think that it is not too much to expect that authority should place an indelible inscription, relative to the above points, on the inner walls of every dwelling. It is, of course, quite practicable to cut out the soil upon which a house stands, and to fill in with charcoal and asphalt, or with concrete, to a proper depth.

It will perhaps be said, "You can see no good in London, and can only perceive its defects." To this I reply, "Not so; the question before me is exclusively one of disease and its prevention. When a man is sick unto death, his doctors are not expected to waste time in discussing his personal merit."

The physicians of Europe are not unaware of the fact that, wherever the marsh poison exists, it is a cause of national degeneracy, poverty, and unhealthiness; but none can perceive the truth of this sanitary platitude more clearly than the physician who has spent a working lifetime in a tropical swamp. On this ground, I trust, Sir, that you will justify me in reverting, perhaps with too much dogmatic earnestness, to a momentous subject which engaged a good deal of my attention before I went to India.*

Except one sentence, referring to a threatened flood in South Belgravia, the whole of this paper was in type previous to the occurrence of the great inundation which has, within the last few days (Nov. 1, 1882), occupied or endangered much of the Thames Valley, including Bankside, Upper Ground Street, Lambeth, and other low-lying spots of which I have spoken. This morning, an unfortunate man writes in the *Telegraph*:—"I live near the Thames; very near the Thames; so near that I can sometimes say, with but little stretch of truth, I live *in* the Thames. It invades my library, as, the other day, it was said to have invaded the library of the House of Lords."

* *Medical Gazette*, vol xxxix, for 1847, p. 122.

# THE SANITARY STATE OF THE BRITISH TROOPS IN NORTHERN INDIA.

By Surgeon-General A. C. C. De RENZY, C.B. (retired).

(*Read: February 7th*, 1883.)

The Society are aware that, in 1859, a Royal Commission was appointed to inquire into the sanitary state of the army in India; and that in 1863 the Commission submitted its report. On its recommendation, the Government of India took several measures of great importance and attended with great expense. Among others, new barracks were built at an outlay of several millions sterling, and a Sanitary Commission was established. As nearly twenty years have elapsed since the Report of the Royal Commission was issued, the time would seem to have arrived when an attempt should be made to estimate the results of the measures adopted. On this occasion I propose to deal with the results in so far only as they concern the troops stationed in Northern India, that being the part of the country of which I have personal knowledge; and my desire is that the conclusions I have to lay before you should be based only on facts which have occurred under my own observation.

The Royal Commission reported that the average rate of mortality of the European troops in India was 69 per 1,000 in the period between the years 1800 and 1856. This period includes the campaigns of Lord Lake and Sir Arthur Wellesley against the Mahrattas, the Pindarri wars, the two campaigns against Nepal, the two Burmese wars, and the disastrous war in Afghanistan, the wars in Scinde and Gwalior, and the two wars in the Punjaub, with all their bloody battles. It is obvious, therefore, that the rate of mortality stated by the Royal Commission is to be regarded rather as a statement of the cost in life at which the British Empire in India had been built up and consolidated, than as an estimate of the actual rate of mortality at the time when the report was issued. It is very necessary to bear this in mind, in making a comparison between the present state of things and that which existed when the Royal Commission reported, as otherwise a most exaggerated idea would be formed as to the value of the results attained in the last

twenty years. Many writers, and public speakers in Parliament and elsewhere, have neglected this caution; and taking the death-rate given by the Royal Commission as a standard, and comparing with it the average death-rate of the last twenty years, which is about 25 per 1,000, have represented

A.

TABLE *showing the average rate of mortality per* 1000 *of strength, and the number of deaths from all and from certain causes in the British Army in Bengal from* 1862 *to* 1880.

| Years. | Average strength. | Average rate of Mortality. | Number of Deaths from | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | All causes. | Cholera. | Enteric Fever. | Other Fevers. | Dysentery and Diarrhœa. | Hepatitis. |
| 1862 | 42,980 | 26.82 | 1,153 | 413 | Not classified. | 144 | 153 | 130 |
| 1863 | 41,351 | 22.49 | 930 | 169 | | 117 | 154 | 150 |
| 1864 | 40,385 | 21.10 | 852 | 103 | | 127 | 93 | 119 |
| 1865 | 37,210 | 24.24 | 902 | 116 | | 138 | 107 | 130 |
| 1866 | 35,013 | 20.11 | 704 | 48 | | 113 | 76 | 95 |
| 1867 | 33,784 | 30.95 | 1,071 | 479 | | 91 | 82 | 89 |
| 1868 | 31,560 | 20.11 | 635 | 57 | | 91 | 54 | 108 |
| 1869 | 34,624 | 42.89 | 1,485 | 570 | | 163 | 123 | 171 |
| 1870 | 34,090 | 21.90 | 746 | 21 | | 142 | 63 | 152 |
| 1871 | 35,122 | 17.83 | 626 | 25 | 60 | 79 | 45 | 96 |
| 1872 | 36,507 | 27.45 | 1,002 | 389 | 59 | 65 | 74 | 86 |
| 1873 | 36,617 | 15.40 | 564 | 33 | 56 | 51 | 34 | 66 |
| 1874 | 37,278 | 14.62 | 545 | 8 | 75 | 41 | 47 | 72 |
| 1875 | 37,184 | 17.32 | 644 | 136 | 59 | 44 | 27 | 55 |
| 1876 | 36,582 | 16.02 | 586 | 115 | 64 | 26 | 41 | 52 |
| 1877 | 36,179 | 11.64 | 421 | 16 | 56 | 24 | 21 | 55 |
| 1878 | 35,836 | 21.63 | 775 | 149 | 168 | 57 | 55 | 67 |
| 1879 | 29,255 | 29.87 | 874 | 262 | 113 | 77 | 71 | 50* |
| 1880 | 31,583 | 27.73 | 876 | 153 | 97 | 84 | 123 | 43* |
| 19 yrs. | 35,954 | 22.63 | 15,391 | 3262 | 807 | 1674 | 1443 | 1786 |
| *Including the Troops on field service in Afghanistan.* | | | | | | | | |
| 1879 | 38,755 | 44.15 | 1,711 | 627 | 178 | 151 | 122 | 62 |
| 1880 | 39,504 | 32.40 | 1,280 | 167 | 146 | 136 | 186 | 54 |

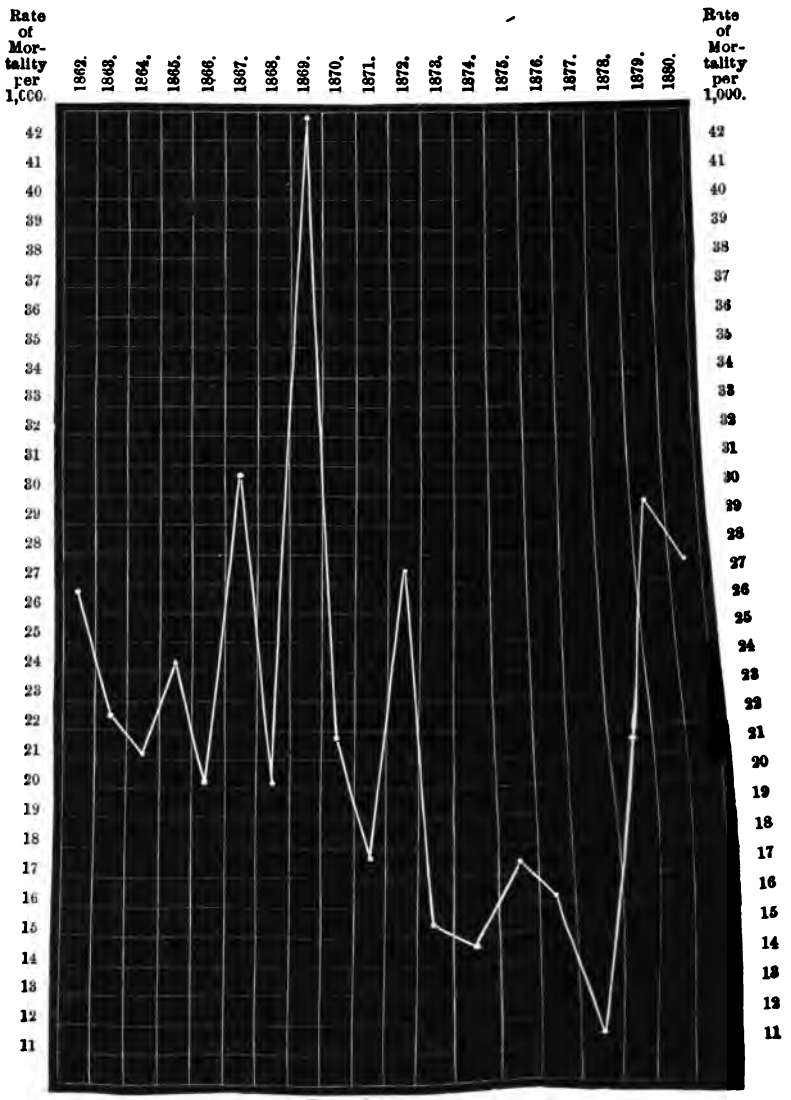
* Excluding the troops in Afghanistan.

the difference, viz., 44 per 1,000, as the measure of the improvement that has been effected. Thus, the Army Sanitary Commission of the Horse Guards, in their review of the Report of the Sanitary Commissioner with the Government of India for 1877, claim the low death-rate of that year as a proof of the great progress that had been made "since the true

principles of improvement were first laid down by the Royal Commission." And in the *Sanitary Primer* for India, pub-

B.

DIAGRAM *showing the fluctuations in the rate of mortality in the British Army in Bengal in each year, from* 1862 *to* 1880, *inclusive.*



lished under the authority of the Government of India, the reduction in the death-rate of British soldiers from 69 to 17 per 1,000, "since sanitary matters were first attended to", is given as a proof of the efficacy of sanitary measures in diminishing disease.

In order to ascertain with precision the amount of change

C.

TABLE *showing the Annual Rates of Mortality per* 1000 *of average strength in the principal Stations in the Plains in Bengal from* 1862 *to* 1881.

| Stations. | 1862. | 1863. | 1864. | 1865. | 1866. | 1867. | 1868. | 1869. | 1870. | 1871. | 1872. | 1873. | 1874. | 1875. | 1876. | 1877. | 1878. | 1879. | 1880. | 1881. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jullunder ... | 12 | 7 | 16 | 6 | 1 | 19 | 33 | 35 | 13 | 15 | 28 | 12 | 7 | 21 | 10 | 9 | 48 | 37 | 39 | 40 |
| Miaumeer ... | 77 | 10 | 25 | 32 | 24 | 17 | 23 | 27 | 24 | 17 | 115 | 21 | 17 | 37 | 19 | 17 | 19 | 47 | 43 | 84 |
| Ferozepore | 19 | 14 | 15 | 19 | 7 | 24 | 9 | 7 | 29 | 11 | 12 | 18 | 21 | 18 | 17 | 13 | 17 | 13 | 13 | 11 |
| Peshawar ... | 62 | 16 | 14 | 17 | 16 | 121 | 14 | 145 | 33 | 22 | 38 | 17 | 9 | 14 | 31 | 3 | 18 | 141 | 61 | 14 |
| Nowshehra | 9 | 9 | 7 | 19 | 15 | 24 | 7 | 43 | 22 | 29 | 10 | 10 | 4 | 8 | 25 | 5 | 17 | 45 | 70 | 10 |
| Rawulpindi | 15 | 5 | 12 | 13 | 11 | 8 | 6 | 17 | 20 | 12 | 21 | 11 | 8 | 9 | 11 | 9 | 12 | 39 | 30 | 18 |
| Sialkot ..... | 13 | 11 | 9 | 11 | 15 | 7 | 7 | 10 | 18 | 16 | 17 | 7 | 7 | 22 | 18 | 16 | 15 | 46 | 12 | 13 |
| Sawgor ..... | 18 | 17 | 22 | 51 | 30 | 15 | 28 | 85 | 16 | 9 | 6 | 5 | 29 | 5 | 11 | 18 | 59 | 6 | 11 | 2 |
| Agra ..... | 55 | 34 | 15 | 21 | 25 | 19 | 8 | 16 | 11 | 25 | 26 | 6 | 7 | 11 | 7 | 20 | 25 | 22 | 21 | 8 |
| Allahabad ... | 18 | 78 | 25 | 33 | 27 | 36 | 28 | 158 | 15 | 26 | 42 | 22 | 18 | 17 | 14 | 12 | 21 | 116 | 55 | 17 |
| Umballa..... | 7 | 11 | 9 | 14 | 13 | 27 | 12 | 14 | 15 | 15 | 21 | 11 | 8 | 22 | 8 | 5 | 19 | 19 | 18 | 8 |
| Morar ..... | 69 | 19 | 15 | 26 | 16 | 38 | 16 | 119 | 32 | 16 | 12 | 16 | 4 | 27 | 6 | 12 | 65 | 52 | 11 | 10 |
| Fyzabad..... | 5 | 13 | 10 | 57 | 20 | 12 | 10 | 34 | 30 | 12 | 37 | 20 | 8 | 17 | 28 | 8 | 79 | 6 | 11 | 6 |
| Sitapur ..... | 8 | 6 | 13 | 20 | 8 | 22 | 19 | 35 | 7 | 13 | 11 | 21 | 7 | 12 | 11 | 10 | 17 | 32 | 72 | 11 |
| Lucknow ... | 15 | 28 | 44 | 27 | 17 | 14 | 22 | 59 | 24 | 17 | 23 | 23 | 18 | 22 | 16 | 10 | 24 | 10 | 35 | 19 |
| Cawnpore ... | 14 | 39 | 25 | 20 | 15 | 23 | 19 | 28 | 21 | 13 | 42 | 19 | 18 | 19 | 22 | 19 | 11 | 26 | 20 | 9 |
| Meerut ..... | 28 | 13 | 13 | 22 | 10 | 93 | 17 | 35 | 27 | 22 | 68 | 16 | 20 | 18 | 17 | 10 | 7 | 14 | 28 | 25 |
| Fort William | 35 | 22 | 21 | 13 | 17 | 10 | 24 | 18 | 12 | 10 | 14 | 9 | 15 | 6 | 10 | 12 | 9 | 5 | 11 | 4 |

that has really occurred, it would be necessary to know what was the actual rate of mortality at the date of the Royal Commission Report, and an allowance would have to be made for the disturbing effect of the Mutiny campaign of 1857, 1858, and 1859, on the health of the troops. It is very difficult to say how large this allowance should be. The hardships and exposure undergone by the troops in that campaign were without parallel in the history of India. The little band that held the ridge at Delhi for four months against disciplined troops at least five times their number, fought in the burning heat of a north-west summer, badly fed, with little rest night or day, and scourged with cholera. The case of the Lucknow garrison was just the same. It is certain that exposure to a burning sun, loss of sleep, bad food, overcrowding, and other insanitary conditions, operating for a period of over two years in that most trying campaign, so damaged the health of the men that the death-rate was raised for some years afterwards considerably above the usual standard.

I think, however, we may assume that by 1862 the exceptional conditions due to the Mutiny had passed away. The additional barrack accommodation, rendered necessary by the augmentation of the strength of the British troops, and by the occupation of new stations, had been provided; overcrowding was at an end, and things had everywhere returned to their usual course. The death-rate of that year, which was by no means a healthy one, cholera having visited several stations in a very virulent form, was 26.82 per 1,000. This, I may say, had been about the average rate of mortality in the Madras and Bombay Presidencies, where the death-rate had not been much affected by field operations for some years. And, as later experience shows that these Presidencies are not healthier than Bengal, the death-rate attained in Bengal in 1862 may, I think, be taken as its average death-rate under the sanitary conditions existing at that time.

The Table A shows the death-rate for each year from 1862 to 1880, the latter being the latest for which statistics are available. This period was one of almost unbroken peace, except for the years 1879 and 1880. In order to make the statistics for these years fairly comparable with those of the previous years, I have excluded from them the figures relating to the troops on field service in Afghanistan. The most marked feature of the Table is the great fluctuations in the death-rate, which ranged from 11.64 to 42.89 per 1,000. A year of very fair health is followed by one of disastrous epidemics. These fluctuations are shown very clearly in

the graphic diagram B. The death-rates of London and other English towns used, in former days, to be subject to similar great fluctuations, but sanitary science has long since succeeded in confining them within very narrow limits. The diagram shows that, as regards the British army in India, we are as yet very far from the attainment of this desirable end.

The statistics of individual stations (Table C) confirm the

D.

TABLE *showing the average rate of mortality per* 1000 *of strength, and the number of deaths from all causes and from certain causes, in the British Army in India from* 1871 *to* 1880.

| Years. | Average strength. | Average rate of Mortality. | Number of deaths from | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | All causes. | Cholera. | Enteric Fever. | Other Fevers. | Dysentery and Diarrhœa. | Hepatitis. |
| 1871 | 56,806 | 17.53 | 996 | 62 | 92 | 99 | 83 | 155 |
| 1872 | 58,870 | 24.21 | 1,425 | 427 | 110 | 81 | 119 | 144 |
| 1873 | 58,769 | 15.30 | 899 | 47 | 79 | 65 | 83 | 137 |
| 1874 | 56,308 | 13.58 | 806 | 11 | 101 | 51 | 75 | 128 |
| 1875 | 58,409 | 17.48 | 1,021 | 194 | 84 | 61 | 57 | 108 |
| 1876 | 57,858 | 15.32 | 886 | 134 | 105 | 34 | 70 | 97 |
| 1877 | 57,260 | 12.71 | 728 | 48 | 92 | 32 | 51 | 93 |
| 1878 | 56,476 | 21.46 | 1,212 | 226 | 206 | 80 | 102 | 127 |
| 1879 | 49,582 | 24.28 | 1,103 | 289 | 147 | 101 | 114 | 87* |
| 1880 | 51,796 | 24.85 | 1,287 | 154 | 168 | 120 | 192 | 69* |
| 10 yrs. | 56,213 | 18.67 | 10,363 | 1,592 | 1,184 | 724 | 946 | 11,45 |

* Excluding troops in Afghanistan.

*Including Troops on field service in Afghanistan.*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1879 | 59,082 | 34.55 | 2,041 | 654 | 212 | 175 | 165 | 99 |
| 1880 | 59,717 | 28.32 | 1,691 | 168 | 217 | 172 | 255 | 80 |

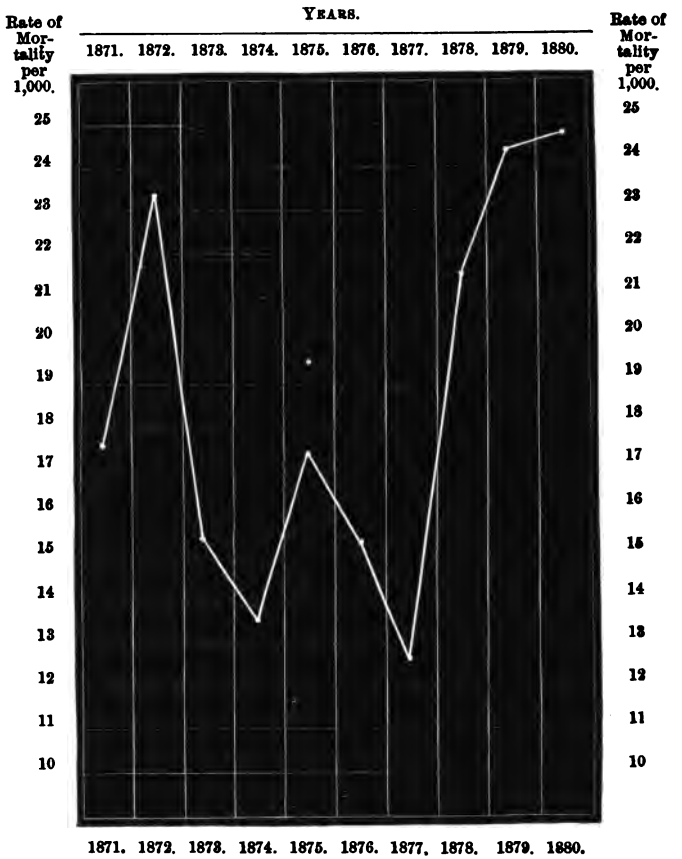
conclusions indicated by those of the Presidency as a whole. With one single exception, that of Fort William, to which I shall invite your attention afterwards, none of the stations show any signs of being secured by permanent defences against epidemic outbreaks. They continue, as before, to be subject to destructive epidemics, one or two years healthy, and then scourged by epidemics of cholera or enteric fever. In 1877, for example, Morar had a death-rate of 12 per 1,000; in 1878, one of 65 per 1,000; Allahabad, in 1879, had a death-

rate of 16; and, in 1880, one of 55; Peshawar had a death-rate of 3, in 1877; and one of 141, in 1879.

The Table abounds with examples of similar fluctuations, which are mainly due to cholera or enteric fever, or both

E.

DIAGRAM *showing the fluctuations in the rate of mortality in the British Army in India in each year from* 1871 *to* 1880.




together. The persistence of the original death-rate is the more remarkable because, in the last twenty years, the proportion of the troops stationed in the Hills has increased from 12 to 26 per cent. of strength; and the proportion annually

invalided to England has increased from 28 to 40 per 1,000. These two measures have, no doubt, tended strongly to reduce the rate of mortality in India, but the fact that it has remained nearly stationary appears to show, either that some counteracting influence has been in operation, or that the main causes of sickness and mortality have not yet been touched.

On referring to Table A, you will observe how large a proportion of the deaths in each year is due to cholera, enteric fever, dysentery, diarrhœa, and other fevers. Taking one

F.

TABLE *showing the average rate of mortality per* 1000 *of strength, and number of deaths from certain causes in the British Army in Madras from* 1862 *to* 1880.

| Years. | Average strength. | Average rate of Mortality. | Number of Deaths from | | | |
|---|---|---|---|---|---|---|
| | | | Cholera. | Enteric Fever. | Other Fevers. | Dysentery and Diarrhœa. |
| 1862 | 12,531 | 20.83 | 46 | Not classified. | 15 | 24 |
| 1863 | 12,621 | 22.11 | 47 | | 20 | 30 |
| 1864 | 12,993 | 23.24 | 36 | | 37 | 37 |
| 1865 | 13,059 | 24.96 | 36 | | 33 | 57 |
| 1866 | 11,378 | 24.08 | 28 | | 24 | 53 |
| 1867 | 10,793 | 21.40 | 3 | | 12 | 41 |
| 1868 | 10,158 | 23.72 | 7 | | 14 | 23 |
| 1869 | 10,880 | 23.34 | 27 | | 15 | 30 |
| 1870 | 9,936 | 23.65 | 37 | | 16 | 25 |
| 1871 | 10,844 | 20.10 | 36 | 16 | 9 | 25 |
| 1872 | 11,544 | 18.98 | 2 | 27 | 8 | 32 |
| 1873 | 11,487 | 18.29 | 14 | 9 | 8 | 42 |
| 1874 | 11,501 | 12.96 | 1 | 12 | 2 | 22 |
| 1875 | 11,041 | 14.85 | 4 | 7 | 4 | 16 |
| 1876 | 11,034 | 15.77 | 17 | 22 | 5 | 19 |
| 1877 | 10,989 | 16.83 | 19 | 22 | 3 | 24 |
| 1878 | 10,815 | 21.82 | 30 | 13 | 12 | 35 |
| 1879 | 10,444 | 16.66 | 24 | 15 | 8 | 19 |
| 1880 | 10,310 | 10.18 | 1 | 14 | 4 | 8 |
| 19 years | 11,282 | 19.14 | 415 | 157 | 249 | 562 |

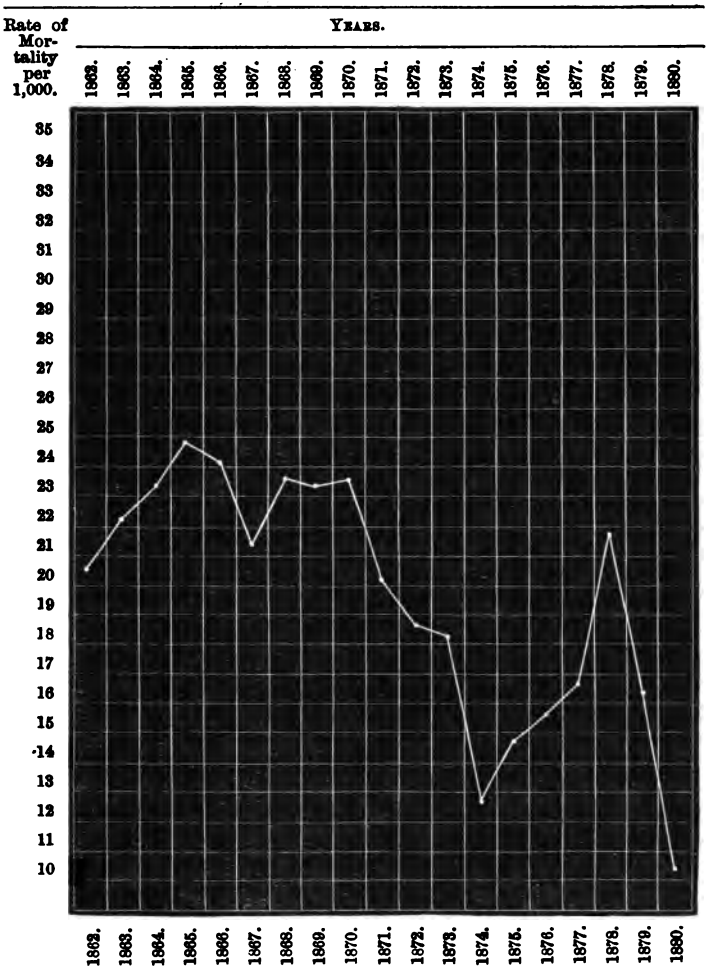
year with another, about 47 per cent. of the total mortality is caused by these diseases.

I now proceed to inquire into the causes of this excessive mortality from diseases usually considered eminently preventible. When destructive epidemics occur in India, the official reports give very full statistical details of the sickness and mortality that result from them, but there is very little information regarding the causation of the outbreaks. The epidemics are attributed to "the unhealthy influences of the

season", or to "endemic and climatorial causes." In the great majority of cases, it is simply stated that "no sanitary defects could be found". In 1878, fifty-seven British soldiers

G.

DIAGRAM *showing the fluctuations in the rate of mortality in the British Army in Madras in each year from* 1862 *to* 1880.




were killed by cholera at Fyzabad in a few days, and the only explanation given of this calamity was that "it was

probably due to heavy rain, after a long drought". The loss of the same number of men in the same year at Morar was attributed simply to "want of rain". Underlying this method of reporting on epidemic outbreaks there is a want of faith in the power of sanitary science to control their ravages. The late Dr. Bryden, to whom India owes so much for the labour and ability with which he arranged the medical statistics of the country, expressly states that, in dealing with cholera, "sanitation must be directed against the inevitable". Very

H.

TABLE *showing the average rate of mortality per* 1000 *of strength, and the number of deaths from certain causes in the British Army in Bombay from* 1862 *to* 1880.

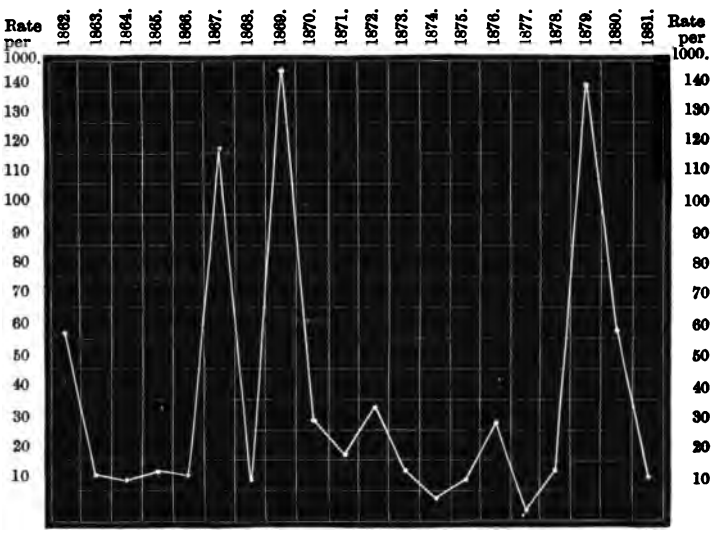
| Years. | Average strength. | Average rate of Mortality. | Number of Deaths from | | | |
|---|---|---|---|---|---|---|
| | | | Cholera. | Enteric Fever. | Other Fevers. | Dysentery and Diarrhœa. |
| 1862 | 11,870 | 24.60 | 55 | Not classified. | 39 | 52 |
| 1863 | 12,329 | 16.14 | 8 | | 17 | 26 |
| 1864 | 12,173 | 18.48 | 25 | | 27 | 24 |
| 1865 | 11,899 | 36.34 | 189 | | 35 | 31 |
| 1866 | 12,077 | 15.06 | 8 | | 25 | 14 |
| 1867 | 11,866 | 21.07 | 58 | | 35 | 25 |
| 1868 | 9,820 | 15.48 | 8 | | 14 | 14 |
| 1869 | 10,509 | 21.40 | 55 | | 30 | 14 |
| 1870 | 10,557 | 18.73 | 1 | | 55 | 16 |
| 1871 | 10,840 | 14.02 | 1 | 16 | 11 | 13 |
| 1872 | 10,819 | 18.86 | 36 | 24 | 8 | 13 |
| 1873 | 10,665 | 11.72 | 0 | 14 | 6 | 7 |
| 1874 | 10,529 | 10.64 | 2 | 14 | 8 | 6 |
| 1875 | 10,184 | 20.92 | 54 | 18 | 13 | 13 |
| 1876 | 10,242 | 12.30 | 2 | 19 | 3 | 10 |
| 1877 | 10,092 | 12.09 | 13 | 14 | 5 | 6 |
| 1878 | 9,825 | 20.46 | 47 | 25 | 11 | 12 |
| 1879 | 9,883 | 15.78 | 3 | 19 | 16 | 24 |
| 1880 | 9,803 | 30.90 | 0 | 57 | 32 | 61 |
| 19 years | 10,841 | 18.68 | 565 | 220 | 390 | 381 |

similar ideas have been expressed by high authorities regarding the fevers that have of late years, thanks to my friend, Dr. Scriven, who first identified them, been classified as enteric fever. The pythogenic origin of these fevers in India has been declared utterly untenable, on the ground that the pythogenic conditions in which the disease is found to occur in Europe "are simply non-existent in Indian cantonments". So far is this argument pushed that, although these fevers have all the symptoms and all the pathological consequences

which characterise enteric fever in Europe, it is contended that in reality they are not enteric at all, and that they are really due "to endemic and climatorial causes". If this idea of the causation of enteric fever be correct—if it be really the fact that cholera, dysentery, diarrhœa, and enteric fever commit the terrible ravages shown in the Table in places where no sanitary defects exist sufficient to account for the prevalence of these diseases, there is no room for hope that the pestilences of India will ever be brought under control. But the question arises, "Do these outbreaks of pestilence occur in places where there are no sanitary defects?"

I.

DIAGRAM *showing the fluctuations in the rate of mortality per* 1000 *at Pishawar from* 1862 *to* 1881.




To discuss this question fully would occupy more time than I could devote to it on an occasion like this. I must, therefore, confine myself to pointing out a few of the most serious sanitary defects now existing, and I think that the facts I shall lay before you will satisfy you that the case against the pythogenic origin of enteric fever and cholera is by no means so strong as it has been represented.

As regards barrack accommodation, I believe no troops in the world are better housed. It would be impossible to speak too highly of the liberality of the Government in this matter. Immense sums have been devoted to the construction of new barracks, and the removal of defects in old ones.

The floor space per head is hardly ever under 80 feet, and the cubic space amounts to 1,500 feet per head as a minimum. Usually it is much more. In a climate which admits of the doors and windows being left open all day at every season, and all night as well at most seasons, this allowance of space must be considered ample. The men have good food, clothing good and suitable to the climate, and very light work. The night duty is usually extremely light, the men having eight or ten consecutive nights in bed. As regards drainage, I do not know of a single station in which the subsoil is not perfectly dry. In most places in the Punjaub, in fact, it is so dry that it would not support any vegetation whatever, without artificial irrigation. In some stations, owing to the extreme flatness of the surface, the rainfall has some difficulty in escaping, and forms shallow pools, which remain for twenty-four hours or so after heavy rain. There is no such thing as a covered sewer anywhere, all excreta, liquid and solid, are removed by hand and carts. The latrines and urinals are on the dry earth system, and are kept surprisingly neat and clean. As regards surface cleanliness, I have seen no town in England that could be compared with a British-Indian cantonment. The Government have spared no expense in providing the establishments required for the maintenance of surface cleanliness. The weak point in the sanitary system is the water-supply. In the plains, water is obtained from wells, of which there are a vast number in most cantonments; in some probably two or three hundred. Upper India is a vast alluvial plain; and where the subsoil water is near the surface, that is, within twelve or twenty feet, as it is in most places, the construction of a well does not cost much, and, as the water is everywhere distributed in leather bags (called mussacks), by human labour, supplemented by bullocks, in order to save carriage, wells are made everywhere. Almost every house, or small group of houses, has its well. No attention is given to the selection of a site for a well. I have seen a hospital well within 3 feet of a leaky cook-house drain and cesspool. In another case, I have seen wells put within leakage distance of a roadside drain, in sandy soil, into which the drainage of washhouses and urinals discharged, and was completely absorbed. In another case, the station-drains, about 3 feet deep, with flat, uneven bottoms, on which the drainage formed stagnant pools, passed within 20 feet or so of the wells, in which the water stood at a depth of 12 feet or so from the surface. The steaning of the wells is very rough, and is quite pervious to water.

Of late years the wells which supply the troops have been covered with boards. These covers are so arranged that the water-carriers, in lifting the water, which they do with a leather bag suspended by a rope, each carrier having his own bag and rope, have to stand on the covers. In the crevices between the boards is found a very offensive stuff, consisting of epidermis, fibres of cotton wool. There is a constant trickling of water into the well, carrying down the washings of the bhisti's (waterman's) feet, and other impurities. The water used for drinking is filtered through a Macnamara filter; the filtering medium being sand and animal charcoal. There are usually from sixty to eighty of these filters in a regiment. There are very strict orders that the filters be kept in a good state; but as there are so many of them, and the system requires unremitting vigilance, failures are inevitable. In one case, on emptying the filter, I found the nodules of animal charcoal so enveloped in mud, that the contents seemed, at first sight, one homogeneous mass of mud. In another case, the sand was found to have been taken from the bed of a nulla close to the spot where the bazar drain discharged. The filter usually stands in the verandah, and, in the hot weather, when the thermometer rises daily to 105 deg. or 115 deg. Fahr. in the shade, the contents of the filter becomes so hot, that it is undrinkable, having a temperature of 80 deg. to 90 deg. Fahr. Under these circumstances, there is great difficulty in ascertaining what the men drink. Their orders are to drink none but filtered water, and naturally they do not like to admit that they have disobeyed this order. Many men have told me that they do not use the filtered water. Many use an effervescing liquor called "pop". In one case I found that the pop was made by a native who lived in the native city, and his well, in which the water was only 12 feet from the surface, was situated within 10 feet of a dunghill on one side, and within 12 feet of a filthy latrine on the other. In some regiments, in order to cool the water, it is drawn from the filter and stored in porous wide-mouthed earthen jars, from which the men draw the water as they require it, by dipping their panikins into the contents, or by stooping the jars; their fingers, often far from clean, coming into constant contact with the lips and contents of the jars. In many cases, the coolest water is obtainable in the washhouses, and my belief is that this water is largely used for drinking purposes. The washhouse arrangements are very primitive; a few half-casks are used as tubs to hold the water. The men ladle the water with their basins out of the tubs. The arrange-

ments of water for cook-houses are of the same kind. A tub holds the supply, and the water is ladled out as required.

Such are the arrangements in general use for the supply of water; but in some cases there is an additional element of danger. Thus at Peshawar, owing to the subsoil water being at a depth of 100 feet, wells are scarce, and the wash-house water used to be got from an open roadside duct or gutter. I am glad to say that this arrangement ceased six months ago; but still a description of it will be of use, as an illustration of the system that was thought good enough for thirty years, for this most important frontier post. Fourteen years ago I found that the duct ran through a number of graveyards, and that the Peshawarees attached great virtue to having their friends buried close to the water. Noticing a fresh grave close to the duct, I observed gas bubbles rising through the water, and on testing a specimen of the water taken at the spot, it gave a decided reaction of ammonia. In the bazar at Peshawar, from which the troops get their supplies, milk, etc., this was the only water available, for the well water was too far off and too expensive, owing to the cost of carriage, for poor people to be able to use it. At different points along the course of the duct, which in its various ramifications through the station measured 52 miles, and was from 2 to 3 feet wide and 6 in. deep, shallow ponds were made, and from these the people supplied themselves. The water is so muddy, that it has to be let stand for some hours before the people can drink it. Imagine Piccadilly supplied with water from an open gutter flowing alongside the pathway, with small ponds at certain intervals, and some idea may be formed of the state of the water-supply of the Peshawar bazar, as it has been for thirty years, and as it remains at this day. The water-supply of the Peshawar bazar is exceptionally bad; but I do not know of a single bazar in Northern India in which it is not in a most dangerous state. The Meerut bazar may be taken as a type of bazars in general. Many of the wells in that bazar are within a few feet of flat-bottomed, ill-constructed drains, in which, from want of fall, sewage lies stagnant for hours, and has to be swept away daily by hand. As the supplies for the troops all come from the bazars, and the men cannot be kept from visiting these places, the sanitary condition of the bazars reacts on the health of the troops in a thousand different ways, which will readily suggest themselves to you.

The arrangements, or rather the entire want of them, for the supply of pure water for washing clothes, are a source of

great danger. The station clothes are usually washed at some nulla, which, as often as not, is the natural drain of the cantonment. At Lahore, a large part of the washing was done in the city sewer water, after the subsidence of the suspended matter. I have seen scores of washermen washing clothes at Umritzar in the city ditch, into which the city sewers discharge. At Rawalpindi most of the washing is done in the Leh Nulla, below the native town. In many places a tank or pond is used for clothes-washing. From long-continued use the tank becomes practically a foul cesspool. At Abbotabad, the headquarters of the district I was lately attached to, the clothes are washed in the nulla, which is the natural drain of the native town. I think it likely that this is the origin of the bad reputation for puerperal fever which this beautiful little spot has long had.

Such being the state of the water-supply of permanent stations, it is not surprising that the arrangements for troops on field service are even worse. In illustration of this statement, I shall give the case of a British regiment which I had occasion to investigate on its return from Afghanistan. The regiment had an immense sick list, which was supposed to be due to malaria, and endemic and climatorial causes of disease. The water-supply arrangements were as follows. Water was conveyed in the usual way by bhistis, and it was stored in open metal buckets, one for each tent, which was fastened to the tent-pole, and the men ladled the water out of the buckets with their panikins.

In the hospital the same system was in operation. I there saw a patient who was vomiting on the floor, and the air being intensely dry and hot in the daytime, it was thick with dust, which was being continually deposited in the buckets. No doubt the vomit was quickly desiccated, and dispersed through the air as dust. On testing a specimen of the water, I found it grossly polluted. Can any system be conceived better adapted than this for the propagation of diseases communicable through the medium of water?

I have been careful to give you full details of the state of the water-supply, for two reasons. First, because, as Dr. William Farr complained thirty years ago, the information given on the subject in Indian Sanitary Reports is very scanty; and secondly, because the opinions I hold on the subject differ greatly from those recorded by men of great ability and high reputation. The facts I have laid before you, and I do not think the correctness of my statements will be disputed, will enable you to form your own opinion on the question at issue. I have long thought that the medical

authorities did not fully realise the extent of the evils arising from the state of the water-supply. There has been an apparent unwillingness on the part of many most distinguished medical authorities in India, to admit that the prevalence of such diseases as cholera and enteric-fever was mainly due to the state of the water-supply. The late Dr. Morehead, one of the ablest physicians that ever served the Honourable East India Company, has recorded his opinion that "bad water was not a common cause of disease in India"; and yet, with the introduction of a pure supply of water into Bombay, where Dr. Morehead used to have to treat cases of cholera in hundreds, the disease ceased at once to prevail with epidemic force, and the European population of that city have for seventeen years enjoyed almost as much immunity from the disease as the people of London.

The late Surgeon-General Beatson was apparently of the same opinion as Dr. Morehead. In an able report on the cholera epidemic of 1867, which killed 1,071 British soldiers in Bengal, he makes no mention whatever of the state of the water-supply. Cholera was more than usually destructive at Peshawar that year; but no suspicion appears to have fallen on the water-supply. Its condition is not referred to at all. The epidemic is throughout discussed as connected with endemic or climatorial conditions. Dr. Muir, who succeeded Dr. Beatson as Principal Medical Officer, and afterwards became Director-General of the Army Medical Department, held similar views. In his Report for 1870, he altogether rejects the idea that the epidemics among the troops were due to the state of the water-supply. "An opinion", he says, "seems to have got abroad, especially in England, that the European troops are very indifferently provided with water of a pure and wholesome quality, and that much of the disease to which they are subject is traceable to this source. I believe this idea to have been an exaggerated one. With few exceptions, the supply is adequate and wholesome."

The testimony of Surgeon-General Cuningham, Sanitary Commissioner with the Government of India, is to the same effect. In his report for 1872, he says, "that it would be a gross exaggeration, as it would be pure assumption, to affirm that the troops and other communities who were attacked, suffered because they drank water which had been contaminated with cholera discharges." And again: "The belief in the dissemination of cholera through water is founded on bare assertions, altogether unsubstantiated by details; bare asser-

tions such as would not be received by any judicial court, even in the pettiest case that could be brought before it." In accordance with these convictions, he made the following recommendations to Government, when he was asked his opinion as to the measures that were required to place the water-supply on a satisfactory footing:—"Measures are required for preserving the natural purity of the water, and for this purpose the wells should be provided with a ridge-wall, a platform, and a drain to lead away waste water. They should also be periodically cleansed; and, to facilitate this operation, the bottom should be tiled. In the lines of every European regiment, one pump should be fitted to the best well. The water should be raised by the pump, should be passed through a filtering-bed attached to the well, and it should then be received into a metal pail, and thus conveyed to the barrack filter. If these simple appliances are brought into use, nothing more seems necessary to render the water-supply all that can be needed." From the description already given of the condition of the water-supply, you will be able to form your own opinion as to how far these recommendations are calculated to protect troops against the dangers arising from the use of contaminated water. The Royal Commissioners sum up their conclusions on the water-supply, as it existed twenty years ago, in these words:—"It will be seen that the supply for permanent stations is the same as that usually adopted for armies in the field. Somewhat similar methods have always been in use among uncivilised or imperfectly civilised populations." Great improvements have been effected in other matters; magnificent barracks have been built; twenty-six per cent. of the troops have been stationed in the Hills; but the water-supply continues, in my opinion, in a state unworthy of a civilised people. And this is the reason why the death-rate has not fallen, and why epidemics of cholera and enteric fever are so common.

Within the last few years the Government seems to have become somewhat impressed with the evils of the existing state of things, but the progress of improvement has been very slow, and serious errors have been committed.

The history of Peshawar illustrates the difficulty of effecting improvement in this matter. In 1870, Lord Mayo visited that station, and closely studied the question of its water-supply. He went there under the impression that the evils of the existing arrangements had been greatly exaggerated. He left the station, firmly convinced that they had been understated; and, within a short time after his return to the

seat of government, he issued peremptory orders for the immediate preparation of a comprehensive scheme. The work had made considerable progress at the time of his death, in 1872. Other opinions now came into play. High military and civil authorities maintained that the water-supply had nothing to do with the sickness of the place, and Lord Mayo's scheme was allowed to lapse for nine years. Two years ago, under Lord Ripon's rule, it was resumed, and six months ago the new water was supplied to the British and native troops. I am sorry to say, however, that the clearness of the lesson in the science of disease-prevention, which this important work is sure to give, is about to be sacrificed to what seems to me a most unwise economy. It appears that the native troops are only to be supplied with the new water for *drinking* purposes, and they are to use tanks supplied from the old gutter, for *ablution* purposes. The serious objection to this arrangement will be understood when I state that no native ever bathes without rinsing his mouth with the water he bathes in, however filthy that may be. Now, I hold that if the British troops in India are to be preserved from epidemic outbreaks, good water in abundance for all purposes, for personal and domestic cleanliness, as well as for drinking, must be made convenient for all classes, whether European or native, and more especially for the native poor residing in military cantonments; and not only this, but in order to ensure that none but pure water shall be used for any purposes whatever, I hold that impure sources of supply in military cantonments should be closed altogether.

In the new works at Umballa, which have just been completed at a cost of £100,000, the principle of making the pure supply convenient for all classes has been ignored altogether, and the method of distribution is such that in summer the water becomes so hot that it cannot be drunk. The water is conveyed through the station in a closed masonry-duct, raised some two or three feet *above* the surface; and in connection with the duct, small reservoirs, some six feet *below* the surface, are placed in different parts of the station, from a quarter to half a mile apart. The reservoirs are approached by stairs of eight or ten steep steps, and the water carriers, having filled their mussacks at the taps fixed in the reservoirs, have to toil up the steps and carry their burden to its destination. It is quite impossible that, under such a system, water could be used in the quantity which is essential for personal and domestic cleanliness. The inconveniences of the system are so great that a few weeks ago,

when walking through the bazar, I was not surprised to see the natives supplying themselves from a well situated on the edge of a large excavation which receives the drainage of the bazar and the adjoining neighbourhood. The evil of having the water heated to a degree which renders it undrinkable, through being conveyed in a channel exposed to the full force of the sun, cannot be appreciated in a climate like that of England.

So far, your attention has been drawn only to defects. I now beg your attention to the results attained in a case in which sanitary requirements, as they are understood in England, have been fairly satisfied—I refer to the case of Fort William in Calcutta. This fortress is situated in a locality which has many grave disadvantages. The site is so low that it is only six feet above the high-water level of the Hughly, and within five miles of it is situated the Great Salt Lake, or rather swamp, twenty-eight square miles in extent. The existence of this swamp, and also the close proximity of the Sunderbunds, a vast tract of jungle and swamp, 20,000 square miles in extent, are constantly referred to by the older writers on Calcutta as the main and the immediate sources of the unhealthiness of the city. Rice is the staple crop grown in the vicinity, a fact which sufficiently denotes the hygrometric condition of the soil. From the necessities of the case, the buildings in the fort are placed close together; and the best barracks, the Dalhousie, are so wide (64.5 feet) that there are four rows of beds in the breadth of the building, an arrangement particularly objectionable in a climate where the air is not only hot and moist, but remains also in a state of stagnation for long intervals, more especially at night.

It is difficult to imagine a combination of circumstances more unfavourable for the health of British soldiers. A few years ago it was one of the most unhealthy stations in India. The Royal Commission gives the death-rate of the fort, for a long series of years, as 68.96 per 1,000, and, for the ten years ending in 1856, as 102.35 per 1,000. In the ten years ending in 1880, the average death-rate was 10.60 per 1,000. There is no clear record of the measures that wrought this remarkable transformation; but I have collected the following information on the subject. Improvements began to be made in the water-supply about the year 1860; and, after several alternations of zeal and neglect, they were only completed in 1872, when the Calcutta municipal water was laid on all over the fort. In former days the supply was taken from a large number of tanks, some near and convenient,

some remote and inconvenient; some more, some less, exposed to pollution. The first improvement made was to limit the number of sources, a number of tanks being closed, and, later, water was taken from a tank on the glacis, and laid on in pipes. This arrangement, obviously defective as it was, was an immense improvement on the former state of things; but the unremitting vigilance which was necessary to preserve the gathering ground of the tank from pollution was sometimes wanting. The glacis water is still used for ablution purposes, but, as the municipal water is everywhere convenient for use, it is to be hoped that the glacis water will not often be used for drinking. At the same time, it is greatly to be desired that none but municipal water were available for any purpose. Now, I do not contend that the improvement in health in this case is due exclusively to the change in the system of water-supply. Fort William, like other stations, has benefited by the greater attention given of late years to conservancy; but, as conservancy alone has not secured the stations of Upper India against epidemics of cholera and enteric fever, it is, I think, fair to infer that in the case of Fort William the change in health is due mainly to the improvement of the water-supply.

It is surely an encouraging fact that, while in the decade ending in 1880 the average death-rate of the troops stationed in England was 8.68 per 1,000, the death-rate of the troops stationed in Fort William, in the same period, was only 10.60 per 1,000.

Among the indirect effects of the present system of water-supply, the prevalence of intemperance demands serious attention. In a climate like that of Northern India, where for several months the thermometer in the shade rises to 105 or 115 deg., and where the air is intensely dry, there being for a long time a difference of from 30 to 35 deg. between the dry and the wet bulb thermometers, an abundance of water, cool and pleasant to the taste, is an indispensable requisite for health. The water now available often has a temperature ranging from 80 to 90 deg. Fahr., and, it being so insipid, the men take to alcoholic drinks, and use them to an extent quite incompatible with health. The amount of sickness in India, due directly and indirectly to alcohol, is very considerable. Hepatitis kills about seventy men, and heat-apoplexy about one hundred men a year. These two diseases are closely dependent on the use of alcohol in hot, close atmospheres, in quantities greater than can be assimilated. Alcohol has a marked effect in lowering the power of resisting high temperatures; and this effect is greatly intensi-

fied by the men, in their eagerness to get liquor, crowding after sundown into the canteens to an extent far greater than the ventilation of the buildings set apart for the purpose was calculated to provide for. You must have noticed how apt people in this country are to lose consciousness during very hot weather in crowded churches and theatres; and, if you will conceive a building like a canteen, crowded to its utmost capacity, with the thermometer standing, it may be, at 100 deg., you will, I think, have no difficulty in understanding why epidemics of heat-apoplexy are so common. Many years ago, in a season of extraordinary heat, I obtained an order that the men under my charge were not to be allowed to enter the canteen at all, and that their liquor was to be served out to them as they sat on benches in the open air. The result was a great success; but, as I stood among the men and saw their intense eagerness for liquor, I felt that, although the open-air distribution of liquor removed one source of danger, it did not touch the root of the evil. The craving of the men for alcoholic liquors is the natural product of the impossibility of getting cool, drinkable water. It is a fact, I think, not generally known, that the great majority of cases of heat-apoplexy occur after sundown. The barracks become ovens in the daytime, but, as there is usually a strong breeze, the heat is not felt very much. In the evening the breeze fails. There is no perceptible movement of air, and clouds appear in the sky, impeding escape of heat into space. The heat radiated from the barracks now becomes unbearable. In order to remedy this state of things, I proposed, some years ago, that, in connection with a reformed water-supply, arrangements should be made for douching the barracks after sundown, so as to cool them and enable the men to get refreshing sleep. To men who have drunk alcohol freely, though far short of intoxication, the heat radiated from the barracks at night is a powerful cause of heat-apoplexy.

Another result of the water-supply is the prevalence of dust—the air is loaded with dust and the roads are ankle-deep in dust. It would be difficult to convey to one who has not served in India a correct idea of the discomfort—to use no stronger term — which the British soldier suffers from dust. He, of course, has to move about on foot, and he must often find the dust almost suffocating. When Lord Ripon was entering the station of Umballa a few months ago, I was told that he and his escort became quite invisible for a time, being enveloped in a dense cloud of dust. The indolent habits of the soldier, of which one so often reads, are not a little due to the dusty state of the roads, which makes it im-

possible to take a walk with any pleasure. With water distributed by bhistis there is no possibility of keeping down dust. Moreover, the plan on which the stations have been laid out makes the solution of the dust-difficulty a serious matter. Owing to the prevailing belief that the wide dispersion of barracks affords the best security against cholera, it has come to pass that the barracks of a single regiment cover an area of several square miles. The cantonment of Mianmir is ten square miles in extent. This system makes the supply of water in pipes a very costly matter. The case of Fort William shows that the belief on which the system rests is an entire mistake, and that a very considerable condensation of population is quite compatible with freedom from epidemic diseases, provided that an abundant supply of pure water affords ready means for maintaining cleanliness and keeping down dust.

The state of the water-supply being as I have described it, the experience attained in England warrants, I think, the opinion that it is adequate to explain the great prevalence of cholera and enteric fever in India, for Nature does not work on one plan here and on another in India. And yet it is a fact not to be disputed that the weight of medical opinion in India is against this opinion, and that many very able men fail to see any causal relation between the state of the water-supply and the diseases in question. How is this fact to be explained? I think if you will recall the steps by which the connection between cholera and contaminated water was established in this country, you will understand why the connection is not perceived in India. When cholera visited England, in 1832, there was an utter chaos of opinion as to its mode of propagation. Its causes were supposed to be enveloped in inscrutable mystery, and to be beyond human control. "The cholera", said the *Annual Register* for that year, "left medical men as it had found them, confirmed in the most opposite opinions, or in total ignorance as to its nature and the causes of its origin." It was not until 1854 that definite views began to prevail generally in the profession. What had happened in the meantime? Two events of the greatest moment. The registration of deaths had been established, and the water-supply of London had made great progress towards simplicity and purity. The registration of deaths, and the causes of deaths, made it possible for the first time to estimate the incidence of mortality in different places, and the simplification of the water-supply made it possible to estimate the influence of different waters in the propagation of the disease. The proof of the connection between the

spread of cholera and the state of the water-supply was complete when it was found that in South London the incidence of the disease in the Lambeth water-field, which had been equal to that of the Southwark water-field in the epidemic of 1849, and whose pipes ran through the same streets, supplying houses of precisely the same class, and standing door to door, had fallen in the epidemic of 1854 to one-eighth of the Southwark ratio; the only change that had occurred in the meantime being that the Lambeth Company had removed its in-take to a comparatively pure part of the Thames, while the Southwark Company continued to take its supply as before from the polluted river at Hungerford Bridge. How impossible would this demonstration have been if there had been no registration of deaths, and if London had been getting its water-supply from twenty or thirty thousand wells. Now, in India, there is no possibility of ascertaining the causes of deaths among the native population, and the water-supply is taken from an infinite number of sources, none of which have any permanent defences against contamination. One source supplies drinking-water; another, ablution water; a third, water for adulterating milk; a fourth, water for washing clothes; a fifth, for washing vegetables. I have seen men washing radishes in the sewage of the Umritzar ditch. No two barracks have the same water, and the guard-room water differs from the barrack water, and the canteen water from both. Under the most favourable circumstances the facts are exceedingly complex, and to ascertain them with certainty is a task of inconceivable difficulty.

When an epidemic occurs in this country, the first thing the Inspector deputed to investigate it does is to collect the statistics of the distribution of the disease, and to examine the state of the water-supply, sewerage, and other probable sources of the epidemic, and in this work he receives the hearty co-operation of the local medical men, and of the public at large. How different is the case of India? Except for the troops and convicts, and a few large towns, there are no reliable statistics at all. The statistics of cantonments are even worse than those of the general population. In nine cases out of ten, a sick native receives no skilled medical aid at all. Skilled medical men are dotted over the country, scores or even hundreds of miles apart. Then, the minds of the Natives are full of strange fears and prejudices, so that their instinct is rather to baffle than to facilitate inquiry. At one time a report gets abroad that the Government are in urgent need of a very precious oil, which is only to be

obtained by distillation of human brains; at another, it is reported that persons infected with cholera are carried off, *nolens volens*, to hospital, and that their houses are to be disinfected. The fear, which is the effect of these reports, leads to a general concealment of cases; and if a patient dies, and his death has to be reported, he is reported to have died of fever, or some trivial ailment, and to have been ill a month, while, in truth, he had been ill only a few hours. It is the complexity of the conditions in which epidemics arise, and the impossibility of getting full and reliable information of the facts, that make the results of epidemiological inquiries in India so indecisive.

In the Presidency towns of Bombay and Calcutta, and in the town of Nagpur, things have of late years made great progress. The water-supply has been simplified, pure water has been laid on in pipes, and impure sources have been closed, death registration has been made effective. The results obtained in these cases show a well-marked causal relation between the state of the water-supply and the prevalence of cholera. It is only by quasi-experiments of this kind that the question at issue can be finally settled.

The subject I have thus imperfectly dealt with is one of immense importance. The fabric of the British Empire in India visibly rests on the health of the British troops, but the importance of the subject extends far beyond them. It concerns the teeming millions of the native population. Orientals are fatalists. Epidemics, they believe, are special dispensations of Providence, with which it is idle, if not impious, to interfere. When, as a Sanitary Commissioner, I endeavoured to convince native Municipalities of the error of this opinion, I was met by some such arguments as these:—If epidemics be preventable, why have not Government prevented them among the British troops? In endeavours to protect them Government has spent millions. The conservancy of cantonments (Safai) is perfect. The highest authorities have declared again and again that there is no defect in the sanitary arrangements, and yet every year we see that some portion or other of the British troops have to seek refuge from cholera in flight from their barracks, exposing themselves to all the sufferings of life in camp at the hottest season of the year. Situated as I was, I was unable to give an answer which would have been intelligible to my native hearers; but I hope I have satisfied you that I had a valid answer to give. The constant recurrence of destructive epidemics among the British troops is the greatest obstacle to the progress of sanitary improvements among the native population.

To refute Oriental fatalism, a clear demonstration of the preventability of epidemics is required, and such a demonstration can be best made in military cantonments. In conclusion, I submit that the facts and figures I have laid before you warrant the following conclusions:—

1. That, since the publication of the Report of the Royal Commission in 1862, there has been no appreciable reduction in the average rate of mortality among the British troops in Northern India.

2. That, with very few exceptions, the water-supply remains substantially in the state described by the Royal Commission in the following words, viz.: "Somewhat similar methods have always been in use among uncivilised or imperfectly civilised populations."

3. That, so long as the water-supply remains in this state, the health of the troops will lie at the mercy of any accident which may convey the contagia of such diseases as cholera and enteric fever among them, and that it is not necessary, in explanation of the great mortality caused by these diseases, to invoke the operation of such vague causes as "the epidemic constitution of the air", "endemic, and climatorial influence", etc.

4. That the case of Fort William, a locality labouring under the gravest sanitary disadvantages, affords grounds for hoping that the measures which have reduced the rate of mortality among the troops stationed there almost to the standard of mortality prevailing among troops stationed in England, would produce equally good, if not better, results in the naturally more healthy stations of Northern India.

# CAUSES OF THE EXCESSIVE MORTALITY AMONG THE WOMEN AND CHILDREN OF THE EUROPEAN SOLDIERS SERVING IN INDIA.

By JOSEPH EWART, M.D., F.R.C.P.

(*Read: May 2nd*, 1883.)

It has always appeared to me that for European women and children connected with the Army of India, the struggle for health—nay for bare existence—has been a very hard one. The truth of this observation first dawned upon me when, as civil surgeon of Ajmeer, in 1854-55, 1855-56, and 1856-57, I held medical charge of the European establishment of the large arsenal there, where I learnt something about the ills, sufferings and trials of the women and children; and this experience was confirmed by further acquaintance with them during a portion of my subsequent residence at Calcutta. It has often occurred to me that a brief review of their health history would be intensely interesting; and I resolved, therefore, when requested by our able Secretary, Mr. Shirley Murphy, to read a paper before this Society, during the present session, to seize the opportunity thus offered to deal with the subject, not only with a view to illustrate the defective hygienic and sanitary condition of these two classes, but also to indicate, as far as the compass of a single communication would allow, the means which might be adopted for its improvement or amelioration. In order to secure as much conciseness as may be practicable, it will be necessary to divide the subject into two sections—the *first* to embrace considerations relating to the high mortality among women, and showing how these affect the health and lives of their offspring; the *second*, those illustrative of the still much greater mortality among children; and, in both cases, to point out the hygienic and sanitary measures which, if liberally adopted, might lead to a material diminution of the existing death-rate, and thereby contribute to their happiness and well-being.

At the outset, it may be stated that, whilst most of these people are of a tolerably pure European stock, there is in

some a certain amount of mixture with Eurasian or East Indian blood. The extent of this cannot be defined with exactness by the facts at my disposal. As, however, the European element preponderates to such a degree as to reduce the Oriental admixture to comparatively small proportions, and as it is quite impossible to separate the two—the grouping of both under one heading becomes unavoidable. Any vitiation thus existing, when closely examined, is not of so much importance as, at first sight, it might appear, inasmuch as the slightly composite character of the facts I am about to submit, would probably have a tendency to keep down the rate of mortality. For though the Eurasian or East Indian wife may not be quite such a good life in her native climate as the Englishwoman is living in the United Kingdom, the former may, I think, with justice, be regarded as a better life *in India* than the latter in the country of her temporary adoption. If, therefore, the coloured wife could be excluded altogether from the account, the death-rates of the women and children of the European soldiers in that part of the world, as given in the published returns, would then be found to be rather under than overstated.

**Women.*—The average death-rate *per mille* among the women of the European Forces in India, during the ten years ending 1880, amounted to 24.527, ranging from 20.33 in 1876 to 36.54 in 1872 (No. 1. App.); in Bengal, from 18.16 in 1877 to 46.12 in 1872 (2. App.); in Madras, from 14.72 in 1872 to 26.95 in 1878 (3. App.); and in Bombay, from 14.62 in 1874 to 33.41 in 1872 (4. App.). Through the kindness of Surgeon-General Marston, I have been placed in a position to give side by side the death-rate of the women belonging to the European troops serving in the United Kingdom and in India, during a period of four years (5. App.). Thus the mortality *per mille,* among the same class of persons was

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|---|---|---|---|---|---|
| In 1877, | 22.50 in India; | | 8.59 in the United Kingdom, | | |
| „ 1878, | 29.20 | „ | 8.65 | „ | „ |
| „ 1879, | 25.00 | „ | 7.75 | „ | „ |
| „ 1880, | 21.05 | „ | 8.37 | „ | „ |

on an average, about *three times* as heavy as in England. The discrepancy is as enormous as it is appalling.

More than half of the mortality, or about 12.667 per thousand, is caused by a few diseases peculiar to tropical

* The statistics in this paper have been compiled from the valuable reports of the late Surgeon-Major Bryden, except when otherwise stated. —J. E.

climates. Febris intermittens accounts for 0.103; febris remittens et continua, in which ought, doubtless, to be included, though not separately distinguished, enteric fever, for 3.038; dysentery, 2.143; diarrhœa, 1.442; cholera, 3.467; splenitis, 0.0017; hepatitis, 1.424; atrophy and anæmia, 1.029 (6. App). The same truth may be arrived at in an equally unerring way. Of the deaths to total deaths, per thousand, from all causes, 4.204, 124.036, 87.596, 58.724, 141.554, 0.700, 2.102, and 42.046, were due to febris intermittens, febris remittens et continua, dysentery, diarrhœa, cholera, splenitis, hepatitis, atrophy, and anæmia respectively, or as much as 517.169, leaving a balance of 482.831 caused by all the fatal diseases in the Indian nosology (7 App.).

The share which malaria and heat have had in the causation of this mortality is only partially apparent from these figures. They are important factors in producing a lowered condition of physical health facilitating the invasion of disease, and rendering recovery from it more or less precarious. The damage so inflicted upon the vaso-motor centres and the hæmopoietic organs paves the way to a mortal issue from many disorders which would otherwise be quite amenable to the remedies employed, such, for example, as dysentery and diarrhœa; for, in moderately sound constitutions, these morbid conditions are manageable enough. The same observation may in a measure be made in regard to heat asphyxia and typhoid fever, both of which are often complicated and aggravated by malaria. It is this, operating in conjunction with the relaxing, enervating and exhausting heat of the plains, which directly caused the admission of 18,012 cases of malarious fever, and 13,404 cases of atrophy and anæmia (or general debility as given in some of the returns) (No. 6. App.), out of an average strength of 58,260 women, during the decennium under consideration; leading secondarily to that impairment of the general health *below par* which predisposes to hepatic and intestinal affections, to miscarriages, premature labours, and the tendency to *post partum* hæmorrhage, milk and puerperal fever, phlegmasia dolens, incompetency during lactation to afford a sufficiency of good wholesome milk for the support of the infant; to the unexpected, sudden and dangerous precipitation of fibrin, as a precursor of a fatal termination, in the right chambers of the heart and the course of the pulmonary artery—first pointed out, in this association with malarious poisoning, by our late President, Sir Joseph Fayrer, in 1866, and to many other disabling and serious maladies. So all-pervading, indeed,

are these two agencies, that the majority of disordered conditions of health met with on the plains of India are influenced, modified, or intensified, by one or other of them or by both.

I had intended to give a detailed narrative of all the other assigned causes of the death-rate, other than that occasioned by the eight climatic diseases aforesaid, during the decennium. But my energy has here failed me. The object in view will be sufficiently accomplished by giving the results for a single year. Thus, in 1880, the death-rate will be found, on reference to the first Table in the Appendix to this paper, to amount to 21.05 per thousand of strength: 8.70 are accounted for by the eight principal diseases previously mentioned; and the balance of 12.35 were caused by the following maladies or classes of disease:—

| | |
|---|---|
| 0.24 | by small-pox. |
| 2.66 | „ phthisis and hæmoptysis. |
| 0.73 | „ apoplexy and sunstroke. |
| 1.21 | „ heart-disease. |
| 0.25 | „ syncope. |
| 1.45 | „ chest-disease. |
| 3.39 | „ diseases peculiar to women. |
| 0.24 | „ abscess. |
| 2.18 | „ diseases not specified. |
| Or 12.35 | per *mille*, from other diseases. |

From the moment the soldier's wife sets foot on Indian soil—sometimes before, during the passage out through the Canal, the Red Sea, or Indian Ocean—she is liable to be confronted with influences inimical to the preservation of a high standard of health. As she is now landed at the port of disembarkation in the winter season, she has not at first to contend against the greatest of all her enemies—*Malaria.* But even at this period she may be exposed to the substantial dangers arising from the direct action of the sun, and have to learn, after painful and bitter experience, that the brain must be protected by efficient headgear, and an umbrella covered with cotton cloth. In the closely approaching hot weather and in the succeeding rains, she is too frequently neglectful of such necessary precautions; in the drying-up season, between the cessation of the monsoon and the commencement of the winter, when most parts of the plains are steeped in malaria—some much more than others, most of all, perhaps, the border lands of marshes, jheels and the terai—she will be fortunate if she escape an attack of ague, or some other ailment—it may be febricula or what is termed seasoning fever—and, if other complaints be taken into ac-

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count, she will with tolerable certainty be laid up at some time during her first year of residence.

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We learn from the sixth statement in the Appendix that, during the decennium, 1871 to 1880, both years inclusive, the admissions of sick women to hospital exceeded the strength by 1,593 cases. But, as it is not always needful for these women to seek admission to hospital or to go on the sick list, for every illness that would be deemed sufficient to disqualify their soldier husbands for military duty, a certain number, not definable with precision, may be borne patiently in their own quarters without being officially reported, and do not therefore find a place in the returns. Be this, however, as it may, it appears that out of a strength of 58,260 women of the European Army of India, there were 59,853 cases of illness, of which 38,294 were due to the eight principal diseases previously mentioned, whilst an over-ruling majority of the remainder were the result of the direct or indirect operation of malaria.

Unlike the contagious and exanthematous fevers, a prior attack, or any number of prior attacks of those produced by malaria, confers not only no immunity from subsequent seizures, but there is every reason to believe that each seizure—especially if the subjects be still resident in districts where the cause abounds and is endemic—would seem to render the liability to future ones greater and greater. Nay, such is the silence and insidiousness of the action of this poison, germ, or bacterium, that, as I have observed, persons may be impregnated with it, without suffering from paroxysmal fevers, in any of the numerous homes of their production—even during long residence and considerable exposure—to be attacked with genuine ague after migrating to the hills which are reported to be free from the generation of its efficient cause, or to this country. Whether in its comparatively stormless action, gradually, —sometimes imperceptibly,—resulting simply in eventual deterioration of the general health without ever developing into paroxysms of fever; or in the tempest of ague; or remittent, sometimes moderately severe, at other times so pernicious as, in its subjective phenomena, to be indistinguishable from typhus, excepting in the matter of its non-contagiousness and the absence of protection conferred by an attack; this thing or condition, which for want of a better term we still have to call malaria, impairs in part the cerebro-spinal nerve centres, and especially the sympathetic ganglia which preside over and regulate nutrition and function generally. Hence, disorders of digestion and assimi-

lation; visceral congestions and enlargements; altered constitution of the blood—anæmia, spanæmia, or leukæmia; the pigmentation of the skin, giving rise to the expressive term of *facies miasmatica;* weakening of the circulatory and muscular systems; and many other morbid conditions and sensations—recognisable in various forms and degrees in the "General Debility", or Atrophy and Anæmia, accounting for 13,404 of the cases included in the decennium under notice.

To the dangers of a tropical sun and malaria must be added, it is feared, not sufficiently good house accommodation, although much improvement has doubtless taken place of late years in this respect; the use of drinking water not effectually chastened by previous boiling and filtering—if we except Calcutta, and, perhaps Madras and Bombay; vegetable and animal food of inferior quality; impossibility, if regard be had to pecuniary means, of obtaining adequate open air exercise, owing to the exhausting heat of the climate, excepting in the winter season; inability to secure the cooling influence of an evenly worked punkah in the days and nights of the hot weather, rains, and drying up period; liability to chill from the general disuse of light flannel next the skin; and childbearing, with a host of diseases peculiar to women, accounting alone for a death-rate of 3.39 per thousand.

But, against these must be recorded the greater comfort of the voyage out in specially-appointed troopships; the care and forethought displayed in conveying the women to their destination during the cold season, a point of primary importance; increased attention to the sanitation of their habitations; the greater numbers now located on the healthiest hill sanitaria for varying periods; the short service system, which, whilst it has diminished the number of women, must leave more accommodation for those who remain in the country, and entail a shorter sojourn on most, if not all.

If we analyse the statistics of the wives of the European soldiers in India during the past ten years, we do not find that very marked progress has been made in the reduction of the still very excessive mortality. From 1871 to 1875, the death-rate was 25.19; and that from 1876 to 1880, was 23.67, showing a decrease of only 1.52 per thousand (1. App.). According to Presidency, the results, for the same periods, were 29.74, against 24.71, showing a more satisfactory decrease of 5.03 in Bengal (2. App.); 17.36, against 21.39, giving an equally unsatisfactory increase in Madras (3. App.); and 20.70, against 23.55, or an increment 2.85 in Bombay (4. App.). Whilst in Bengal the mortality has

of late years been materially lessened, both in Madras and Bombay it has undergone considerable increase.

An attentive comparison of the death-rate in India and England (1 and 5. App., and p. 7) will serve to freshen our memories as to the work which still remains to be accomplished before all the avoidable and preventable sources of disease and death among the women of our European forces in the former country have been extinguished. The bearing of such facts, with others arising out of them, and very briefly outlined in the foregoing observations, will go some way in helping us to understand aright much of the ill-health and deaths among the offspring of mothers living under conditions anything but favourable to the reproduction and rearing of a really healthy and vigorous progeny.

*Children.*—During the decennium ending 1880, the death-rate among the children of the European army of India averaged 67.864 per 1,000 (13. App.). In the quinquennium, 1871 to 1875, it was 71.59; and in that of 1876 to 1880, it reached 63.67, yielding a decrease of 7.92 per *mille* (8. App.). According to Presidency, the death-rate for the corresponding periods was 80.60, against 66.98, in Bengal, furnishing a decrement of 13.62 per *mille* (9. App.); 52.32, against 57.13, in Madras, giving an increase of 4.81 per *mille* (13. App.); 68.35, against 64.83, in Bombay, showing a diminution of 3.52 per *mille* (11. App.). It is, doubtless, satisfactory to find that, on the whole, the mortality has decreased of late years. But that a great deal more remains to be done in the way of reduction is plainly demonstrated by the comparative statement herewith submitted, the part of which relating to the death-rate among the soldiers' children stationed in the United Kingdom has been furnished by Surgeon-General Marston. Thus the death-rate per *mille*, among the same class of children, was—

| | | | | | | |
|---|---|---|---|---|---|---|
| In 1877, | 50.33 | in India; | and | 24.08 | in the | United Kingdom. |
| „ 1878, | 79.73 | „ | „ | 28.41 | „ | „ |
| „ 1879 | 77.06 | „ | „ | 26.86 | „ | „ |
| „ 1880, | 60.43 | „ | „ | 30.28 | „ | „ |

The difference against the children in India is very striking, amounting to 26.25, 51.32, 50.20, and 30.15 per *mille*.

How much of this excessive mortality among the soldiers' children in India has been caused by the same tropical diseases as have been previously shown to have committed such havoc among their mothers is very clearly demonstrated by the following facts. Thus, 0.806 of the deaths to strength per *mille* were caused by intermittent fever; 4.032 by remittent and continued fevers, and in this, enteric or typhoid

fever, though not mentioned, should not be left out of sight; 2.932 by dysentery; 12.425 by diarrhœa; 2.629 by cholera; 0.002 by splenitis; 0.002 by hepatitis; and 6.845 by atrophy and anæmia; making the considerable total of 29.726, leaving a still larger balance of 38.138 to be made up by other causes of death (13. App.).

Of the deaths to total deaths from all causes, 11.882 per *mille* resulted from intermittent fever; 59.411 from remittent and continued fevers; 43.208 from dysentery; 183.364 from diarrhœa; 38.752 from cholera; 0.405 from splenitis; 0.405 from hepatitis; and 100.864 from atrophy and anæmia; in all, 438.023, leaving a balance of 561.977 from all other causes.

On further investigation, I find a considerable proportion of the death-rate is caused by a few diseases peculiar to children, aggravated and intensified, however, in India, by heat, malaria, and other climatic causes, etc. Thus, 3.454 per *mille* were occasioned by tubercular disease; 0.384 by heat-apoplexy, or heat-asphyxia; 2.116 by meningitis and hydrocephalus; 11.355 by convulsions; and 6.936 by dentition; or a total of 24.228 (15. App.); and, of the deaths to total deaths from all causes, 50.904, 5.671, 31.190, 167.026, and 102.214 per *mille*, occurred from these diseases respectively, making up a total of 357.007 per thousand (16. App.). In short, 53.954 per *mille* of the death-rate to strength, and 918.984 of the deaths to total deaths from all causes, have resulted from thirteen diseases or groups of disease, as the case may be, all of which, in their origin, course, and termination, have been directly or indirectly influenced by the prejudicial operation of climatic agencies.

As to age, the death-rate per *mille* among the children of the European army of India varied, under six months, from 244.65 in 1877 to 319.63 in 1879 (17. App.). This is the period when even healthy children, born of healthy mothers, are specially liable to be injured by improper feeding and repeated dosing with castor oil, and when the indigestion caused thereby is likely to be aggravated by the narcotic action of opiated soothing syrups and carminatives. But when the mothers, as I have shown, are not in the enjoyment of a high standard of health, and are, moreover, not living under favourable hygienic, sanitary, and climatic conditions, the children participate by inheritance in an inferior tone of general health, and have to subsist on milk of poor quality, often inadequate in quantity, causing disordered digestion, etc., which is corrected—heaven save the mark!—by the alternate administration of aperients and sedatives.

When the natural food fails, recourse is had to goat's or

cow's milk—seldom, if ever, to a wet-nurse, on account of the expense. And here sufficient care is not taken to see that the same goat or cow is always used; that it is properly fed; that the water for dilution is pure and wholesome; that the proper state of dilution suited to the digestive capacity and wants of the infant is, from time to time, accurately adjusted and regulated; that each meal be given at appointed times. Again, the practice of mixing arrowroot, sago, rice, flour, and other farinaceous or starchy articles of food with the milk, under the delusion that, at this early age, these are nourishing and strengthening—at a period, indeed, before the salivary and pancreatic glands are sufficiently developed to provide material, either in quantity or quality, for their digestion or assimilation, produces much additional mischief, particularly to the puny, weakly, dyspeptic and irritable infants to be seen in the quarters of the married European soldier in India. When to such a state of matters as is here faintly pourtrayed, are added the malarial disadvantages inseparable from residence on the plains at certain times of the year, we are, I think, in possession of a knowledge of most of the circumstances and conditions which lie at the foundation of the greater part of the excessive mortality among infants in India.

From the commencement of the sixth to the end of the first year is the next most fatal period of life, when the average death-rate ranged from 158.73 per *mille* in 1877 to 218.75 in 1878 (*loc. cit.*). We have here to deal with a group thinned of a considerable proportion of its frail and weakly members by the mortality of the first six months. The strongest only have survived. But, superadded to many of the evils, which have been accompanied by such a lamentable loss of life, already enumerated, in part and generally, the present class have to contend against the serious ills of dentition under most untoward circumstances, so unfavourable, indeed, that what ought to be merely a physiological evolution becomes frequently converted into a pathological process. Yet, the upper and lower incisors are, under ordinary conditions, the only teeth cut during this period.

From the beginning of the second year to the end of the eighteenth month is also a very disastrous period for European soldiers' children in India. Among this group, relieved of the weakliest, during the first year of life, and presumably composed only of stronger survivors, the death-rate is still remarkably high, ranging from 137.45 per *mille* in 1877 to 245.16 in 1879 (*loc. cit.*). It is during this period that the anterior molars above and below, and in many cases

the canine or eye-teeth are cut, lighting up, very frequently, fatal convulsions, and frustrating all attempts to cure the accompanying dysentery or diarrhœa.

From the beginning of the eighteenth month to the termination of the second year, we are presented with a class which has been still further weeded of weakly and bad lives. But, owing to the completion of the cutting of canine teeth, and the partial evolution of some of the second molars, and other accumulated disadvantages, the period has proved very inimical to life. The death-rate ranged from 55.87 per *mille* in 1877 to 141.59 in 1878 (*loc. cit.*).

From the commencement of the second to the end of the third year, when the dentition is finished, but during a portion of which period some of the second molars are cut, the death-rate varied from 45.63 per *mille* in 1877 to 118.75 in 1879 (*loc. cit.*).

From the third to the fourth year, the survivors having run the gauntlet of all the inherited and acquired diseases of earlier life, the death-rate ranged from 18.34 to 51.45 per *mille* in 1877 and 1880 respectively. Between the fourth and fifth year it varied from 16.72 in 1877 to 40.71 in 1879 (*loc. cit.*).

I am indebted to Mr. Shirley Murphy for the data which enable me to make a comparison between the death-rate, at certain ages, of the European soldiers' children in India and the children of the general population of this country during 1877, 1878, 1879, and 1880. Briefly put, it shows that it varied—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 to 5 | years, | from | 87.49 to | 138.63, | in India; | 58.2 to | 66.2 | in England. |
| 5 to 10 | „ | „ | 10.06 to | 16.72, | „ | 3.3 to | 3.7 | „ |
| 10 to 15 | „ | „ | 6.29 to | 9.74, | „ | 4.8 to | 5.1 | „ |

Here, again, we have demonstrated the remarkable disadvantages under which the soldiers' children are situated in India.

Having, in the foregoing observations, pointed out the excess of mortality among the wives and children of the European soldiers, and the causes which have chiefly contributed to it, I now propose to invite your attention to the measures which might be adopted for the removal of avoidable sources of disease and death. It is not difficult to indicate them, for they are already well known. The real difficulty consists in having them executed, with fidelity and the requisite liberality—as regards the Government, on account of the cost—as regards the women, on account of their ignorance of the simple principles of personal hygiene and domestic sanitation. No amount of benevolent fore-

thought on the part of the authorities will be successful in effectually accomplishing the object in view, viz., the eradication of all preventable causes of illness and death among the women and their offspring, unless the wives of the soldiers are at all times sufficiently alive to the necessity for the maintenance of the most scrupulous cleanliness in their own persons and those of their children, in their habitations and their surroundings.

Much has been done, more remains to be done, in ensuring the command of two of the essentials for health—plenty of fresh air and good water—by providing increased breathing space, with such arrangements as may be needed for thorough ventilation of the day and night rooms, and by the filtration and boiling of all drinking water. In both these respects—notwithstanding the vast expenditure which has been incurred—there is still room for a good deal of progress and reform. The meat, milk, and other articles of food are not so good as they might be; but it is, perhaps, rather in defective cookery than in the quality of the dietary, as a whole, that the stomach digestion primarily, and the secondary processes of assimilation and nutrition ultimately, suffer.

Personal cleanliness, with daily ablution in the form of a bath, and proper clothing—especially the use of light flannel next the skin—are imperfectly attended to, or neglected. Where are these simple means more conducive to the preservation of health than on the plains of India? Yet inquiry will show that the first hygienic precaution is very commonly, and the second almost universally, ignored by the class to which these remarks apply. Nor should we overlook the disadvantage of their not being able to afford the use of the punkah in the hot weather and rains—leading to the exhaustion of the cutaneous glands sooner than would otherwise happen, with increased proclivity to chills and all the evils of visceral plethora or congestion which are liable to follow them.

They are not sufficiently acquainted with the absolute necessity of avoiding direct exposure to a tropical sun in the summer and monsoon months, and, during such exposure, of shielding the brain and upper part of the spinal marrow with material made of pith or felt, and a well-covered umbrella. Doubtless, Government, in the sanitary and medical departments, has greatly improved the general conservancy; but this is frequently neutralised by the astonishing apathy and ignorance of the women in not maintaining the strictest cleanliness of the bath-rooms and channels or drains leading from them. The generation of malaria is

beyond individual control; but it has been noted in India, as elsewhere, that, with careful selection of site, efficient subsoil drainage, the reclamation and cultivation of marshes, and the provision of sleeping-rooms well raised above the level of the ground or in upper storeys, the fevers caused by it are much diminished in frequency and severity. The location of the women and children at hill stations—particularly those believed to be beyond the elevation at which malaria is reproduced, has also proved beneficial, both as a prophylactic against climatic diseases and their functional, rather than their organic, sequelæ. Then, owing to the exhausting and relaxing character of the heat of the plains, the siesta, or mid-day sleep, is too much yielded to or encouraged, and daily open-air exercise, in the comparative cool of the mornings and evenings, not sufficiently taken.

If means were adopted, on the lines indicated, to perfect the general and personal hygiene and sanitation, the domestic arrangements and surroundings of the soldiers' wives, their health and happiness would be materially ameliorated, and such amelioration would react in improving the health standard, and chances of longevity of their progeny. As things have been, and are, at the present moment, most of the children are born of mothers whose health is below par—under circumstances entailing a feeble, weakly, and impaired condition of physical health. The maternal milk, upon which they have to subsist, is thus inferior in quantity or quality, or both. When recourse is had to artificial feeding, the food is frequently defective in both these particulars in an exaggerated degree. So that I am justified in attributing a considerable proportion of the excessive infantile mortality among the soldiers' children to improper feeding, coupled with deficiency of original constitutional power. Many of the weakliest perish from these causes in the earlier months; many of the stronger survive somewhat longer in deteriorated health, to succumb to disorders incidental to the period of dentition—to intestinal, meningeal, and tubercular disease or convulsions; and many of those who have succeeded in living through the periods of suckling and dentition, with all their concomitant dangers, inherited and acquired, subsequently die from preventable disease, in a vastly undue proportion. When the children become independent of the mother's poor milk, or of the often still poorer substitutes had recourse to, their enfeebled and deteriorated organisms become more and more subjected to all the unfavourable influences which have been shown to exercise such a prejudicial effect upon their

maternal parents. Hence, we are prepared to be told that from the age of five to ten years, the death-rate among the soldiers' children in India was from three to five times, and from the age of ten to fifteen, from one and a half to twice as high, as among the children of the general population of the United Kingdom, during the four years ending 1880.

That the excess of mortality among the children of the Anglo-Indian soldier is, in the main, preventable, may be inferred from the experience gained regarding the rearing of those belonging to the upper orders of European society in India. "It has long been known", says Sir Joseph Fayrer, "to the English in India, that children may be kept in that country up to five, six or seven years without deterioration; and in the higher classes of life with probably as little, if not less, danger to life than in England; for, in some respects—as, for example, scarlatina, measles, whooping-cough, thoracic complaints, and even dentition—they suffer less in India than in England. But after that age, unless a few hot seasons spent in the hills should enable the parents to keep their children in India until a somewhat later age, it is undesirable to do so. The child must be sent to England, or it will deteriorate physically and morally; physically, because it tends to grow up slight, weedy, and delicate, precocious, and with a general feebleness, not so easily defined as recognised—something expressed not only in appearance, but in the very intonation of the voice; morally, because it learns from its surroundings much that is objectionable, and has a tendency to deterioration, which can best be avoided by removal to the more bracing and healthy atmosphere of Europe."

The very excellent results obtained at the European Female Orphan Asylum at Calcutta, as described by Sir Joseph Fayrer in a paper, entitled *On the Health of European Children in Bengal*, read before the Medical Society of London, in 1872, supported by the prior experience of Allan Webb and John Jackson, and my subsequent observation, where only children of pure European descent are received, have shown, from its foundation in 1815 to the present day, that they enjoy health and an immunity from disease and death almost, if not quite, equal to those at home. Although, at this institution, children may sometimes be seen in arms, most, or almost all of them are of an educationable age, and may be said to represent the strongest who have survived the periods of suckling and dentition—so dangerous and critical to those of the classes from which they are derived—owing to a combination of un-

favourable influences which, as has been indicated, are avoidable, removable or preventable. Still, even so, the history of this institution shows that, owing to its admirable hygienic, sanitary, medical, and administrative management, the children are healthy, rosy, firm, hard, robust, and enjoy as much freedom from endemic, and more from epidemic disease, and death, than do those of any cognate institution in England. The same may, perhaps, be said of the Lawrence and other schools established in the hills. But, there is reason to believe that the deteriorating effects of climate are demonstrated, later in life, by a comparative feebleness of the mental and physical health.

In drawing this paper to a close, it has occurred to me that although Government may accomplish much in lessening the excessive mortality among the women and children of the European Army of India, the benevolent objects which it has always had in view will never be attended with the desired measure of success until the maternal parents are taught, in simple, plain and intelligible language, divested of all technicalities, the precepts and principles of personal hygiene and domestic sanitation. That this might be done may be premised from the control which it can and does exercise upon the families of the soldiers through the military department. Thus, every soldier's wife who can read—and now, thanks to the universal introduction of state education in England, the time is fast approaching when every woman in these realms who may become a soldier's wife, will be in a position to read—might be taught the principles of hygiene and sanitation, so that, when required to accompany her husband to India, she may realise the vast importance of pure air, pure water, wholesome food, good cookery, plenty of house room, free ventilation, daily exercise and bathing, avoiding undue exposure to the sun, efficient clothing, a perfect system of conservancy and absolute cleanliness, etc., in ensuring the preservation of her own health, and the proper management and rearing of her children. It would not, I fancy, be a very difficult matter to furnish her with a sanitary primer, written in plain and simple language, setting forth, very briefly and concisely, all the simple truths necessary for her to know, regarding matters relating to the conservation of her own health and that of her offspring. Such a work—intelligible to the commonest understanding—if mastered and acted upon, supplemented wherever and whenever practicable by lectures, would go some way in improving the health and lessening the waste of life among the women and children of the European Army of India.

## APPENDIX.

*Statement* (1) *showing the Mortality among the Women of the European Army of India during the ten years ending* 1880.

| Year. | Strength. | Deaths. | Deaths per 1000 of strength. |
|---|---|---|---|
| 1871 ... ... | 6,384 | 154 | 24.12 |
| 1872 ... ... | 6,650 | 243 | 36.54 |
| 1873 ... ... | 6,626 | 132 | 19.92 |
| 1874 ... ... | 6,627 | 129 | 19.47 |
| 1875 ... ... | 6,335 | 164 | 25.89 |
| Total ... ... | 32,622 | 822 | 25.19 |
| 1876 ... ... | 6,050 | 126 | 20.83 |
| 1877 ... ... | 5,644 | 127 | 22.50 |
| 1878 ... ... | 5,170 | 151 | 29.20 |
| 1879 ... ... | 4,640 | 116 | 25.00 |
| 1880 ... ... | 4,134 | 87 | 21.05 |
| Total ... ... | 25,638 | 607 | 23.67 |

*Statement* (2) *showing the Mortality among the Women of the European Army of the Bengal Presidency during the ten years ending* 1880.

| Year. | Strength. | Deaths. | Deaths per 1000 of strength. |
|---|---|---|---|
| 1871 ... ... | 3,680 | 105 | 26.53 |
| 1872 ... ... | 3,838 | 177 | 46.12 |
| 1873 ... ... | 3,858 | 88 | 22.81 |
| 1874 ... ... | 3,866 | 80 | 20.69 |
| 1875 ... ... | 3,722 | 114 | 30.63 |
| Total ... ... | 18,964 | 564 | 29.74 |
| 1876 ... ... | 3,498 | 80 | 22.87 |
| 1877 ... ... | 3,194 | 58 | 18.16 |
| 1878 ... ... | 2,890 | 94 | 32.46 |
| 1879 ... ... | 2,675 | 76 | 28.41 |
| 1880 ... ... | 2,429 | 55 | 22.64 |
| Total ... ... | 14,686 | 363 | 24.71 |

*Statement* (3) *showing the Mortality among the Women of the European Army of the Madras Presidency during the ten years ending* 1880.

| Year. | Strength. | Deaths. | Deaths per 1000 of strength. |
|---|---|---|---|
| 1871 ... ... | 1,421 | 26 | 18.30 |
| 1872 ... ... | 1,495 | 22 | 14.72 |
| 1873 ... ... | 1,541 | 23 | 14.92 |
| 1874 ... ... | 1,530 | 31 | 20.26 |
| 1875 ... ... | 1,441 | 27 | 18.74 |
| Total ... ... | 7,428 | 129 | 17.36 |
| 1876 ... ... | 1,417 | 27 | 19.05 |
| 1877 ... ... | 1,400 | 37 | 26.43 |
| 1878 ... ... | 1,299 | 35 | 26.95 |
| 1879 ... ... | 1,165 | 18 | 15.45 |
| 1880 ... ... | 982 | 17 | 17.31 |
| Total ... ... | 6,263 | 134 | 21.39 |

*Statement* (4) *showing the Mortality among the Women of the European Army of the Bombay Presidency during the ten years ending* 1880.

| Year. | Strength. | Deaths. | Deaths per 1000 of strength. |
|---|---|---|---|
| 1871 ... ... | 1,283 | 23 | 17.93 |
| 1872 ... ... | 1,317 | 44 | 33.41 |
| 1873 ... ... | 1,227 | 21 | 17.11 |
| 1874 ... ... | 1,231 | 18 | 14.62 |
| 1875 ... ... | 1,171 | 23 | 19.64 |
| Total ... ... | 6,229 | 129 | 20.70 |
| 1876 ... ... | 1,135 | 19 | 16.75 |
| 1877 ... ... | 1,050 | 32 | 30.48 |
| 1878 ... ... | 975 | 22 | 22.56 |
| 1879 ... ... | 800 | 22 | 27.50 |
| 1880 ... ... | 723 | 15 | 20.75 |
| Total ... ... | 4,683 | 110 | 23.55 |

*Statement* (5) *showing the Admission and Death-rate among the Women of the Army of the United Kingdom during the five years ending* 1881.

| Year. | Strength. | Ratio per 1000. | |
|---|---|---|---|
| | | Admissions. | Deaths. |
| 1877 .. | 8,849 | 466.3 | 8.59 |
| 1878 ... .. | 9,939 | 509.2 | 8.65 |
| 1879 ... | 9,160 | 574.7 | 7.75 |
| 1880 ... ... | 9,077 | 557.1 | 8.37 |
| 1881 | 8,592 | 531.5 | 11.06 |

*Statement* (6) *showing the Sickness and Mortality among the Women of the European Army of India, from eight principal diseases of climatic origin, during the ten years ending* 1880.

| Strength, 58,260. | | | Ratio per 1000 of Deaths to | |
|---|---|---|---|---|
| Diseases. | Admissions. | Deaths. | Admissions. | Strength. |
| Febris Intermittens ... ... | 11,440 | 6 | 0.524 | 0.103 |
| Febris Remittens et Continua ... | 6,572 | 177 | 26.932 | 3.038 |
| Dysenteria ... ... ... | 1,870 | 125 | 66.845 | 2.143 |
| Diarrhœa ... ... ... | 3,326 | 84 | 25.255 | 1.442 |
| Cholera ... ... ... | 284 | 202 | 711.267 | 3.467 |
| Splenitis ... ... ... | 190 | 1 | 5.263 | 0.017 |
| Hepatitis ... .. ... | 1,208 | 83 | 68.708 | 1.424 |
| Atrophy and Anæmia .. ... | 13,404 | 60 | 4.477 | 1.029 |
| Total ... | 38,294 | 738 | 19.272 | 12.667 |
| Other Diseases | 21,559 | 691 | 32.051 | 11.860 |
| Grand Total ... ... | 59,853 | 1,429 | 23.875 | 24.527 |

*Statement* (7) *showing the Ratios of Deaths to total Deaths from all causes, from eight climatic Diseases among the Women of the European Army of India, during the ten years ending* 1880.

| Diseases. | Deaths. | Ratio of Deaths per 1000 of total deaths. |
|---|---|---|
| Febris Intermittens ... | 6 | 4.198 |
| Febris Remittens et Continua ... | 177 | 123.862 |
| Dysenteria ... ... ... | 125 | 87.473 |
| Diarrhœa ... ... ... | 84 | 58.782 |
| Cholera ... ... ... | 202 | 141.357 |
| Splenitis ... ... ... | 1 | 0.699 |
| Hepatitis ... ... ... | 83 | 58.082 |
| Atrophy and Anæmia ... ... | 60 | 41.987 |
| Total .. ... ... | 738 | 516.445 |
| Other Diseases ... ... | 691 | 483.554 |
| Grand Total ... ... | 1,429 | |

*Statement* (8) *showing the Mortality among the Children of the European Army of India, during the ten years ending* 1880.

| Year. | Strength. | Deaths. | Deaths per 1000 of strength. |
|---|---|---|---|
| 1871 ... ... | 10,700 | 794 | 74.21 |
| 1872 ... ... | 11,657 | 1,155 | 99.08 |
| 1873 ... .. | 11,860 | 715 | 60.29 |
| 1874 ... ... | 12,393 | 686 | 55.35 |
| 1875 ... ... | 12,359 | 862 | 69.75 |
| Total ... ... | 58,969 | 4,212 | 71.59 |
| 1876 ... ... | 11,882 | 664 | 55.88 |
| 1877 ... ... | 11,266 | 567 | 50.33 |
| 1878 ... ... | 10,423 | 831 | 79.73 |
| 1879 ... ... | 8,993 | 673 | 77.06 |
| 1880 ... ... | 7,596 | 459 | 60.43 |
| Total ... ... | 50,160 | 3,194 | 63.67 |

*Statement* (9) *showing the Mortality among the Children of the European Army of the Bengal Presidency during the ten years ending* 1880.

| Year. | Strength. | Deaths. | Deaths per 1,000 of strength. |
|---|---|---|---|
| 1871 ... ... | 6,039 | 520 | 86.11 |
| 1872 .. ... | 6,560 | 741 | 112.95 |
| 1873 ... ... | 6,753 | 459 | 67.97 |
| 1874 ... ... | 6,953 | 428 | 61.56 |
| 1875 ... ... | 7,017 | 538 | 76.67 |
| Total ... ... | 33,322 | 2,686 | 80.60 |
| 1876 ... ... | 6,602 | 395 | 59.83 |
| 1877 ... ... | 6,182 | 276 | 44.64 |
| 1878 ... ... | 5,773 | 468 | 81.07 |
| 1879 ... ... | 5,196 | 454 | 87.37 |
| 1880 ... ... | 4,462 | 297 | 66.56 |
| Total ... ... | 28,215 | 1,890 | 66.98 |

*Statement* (10) *showing the Mortality among the Children of the European Army of the Madras Presidency, during the ten years ending* 1880.

| Year. | Strength. | Deaths. | Deaths per 1000 of strength. |
|---|---|---|---|
| 1871 ... ... | 2,534 | 127 | 50.12 |
| 1872 ... ... | 2,794 | 191 | 68.36 |
| 1873 ... ... | 2,880 | 148 | 51.39 |
| 1874 ... ... | 3,048 | 134 | 43.96 |
| 1875 ... ... | 3,039 | 148 | 48.70 |
| Total ... ... | 14,295 | 748 | 52.32 |
| 1876 ... ... | 2,920 | 164 | 56.16 |
| 1877 ... ... | 2,880 | 174 | 60.42 |
| 1878 ... ... | 2,658 | 182 | 68.47 |
| 1879 ... ... | 2,273 | 102 | 44 88 |
| 1880 ... ... | 1,835 | 95 | 51 77 |
| Total ... ... | 12,566 | 717 | 57.13 |

*Statement* (11) *showing the Mortality among the Children of the European Army of the Bombay Presidency, during the ten years ending* 1880.

| Year. | Strength. | Deaths. | Deaths per 1000 of strength. |
|---|---|---|---|
| 1871 ... ... | 2,127 | 147 | 69.11 |
| 1872 ... ... | 2,303 | 223 | 96.83 |
| 1873 ... ... | 2,227 | 108 | 48.50 |
| 1874 ... ... | 2,392 | 124 | 51.84 |
| 1875 ... ... | 2,303 | 174 | 76.42 |
| Total ... ... | 11,352 | 776 | 68.35 |
| 1876 ... ... | 2,360 | 105 | 44.49 |
| 1877 ... ... | 2,203 | 117 | 53.11 |
| 1878 ... ... | 1,991 | 181 | 90.91 |
| 1879 ... ... | 1,524 | 119 | 78.08 |
| 1880 ... ... | 1,299 | 76 | 51.58 |
| Total ... ... | 9,377 | 608 | 64.83 |

*Statement* (12) *showing the Admission and Death-rate among the Children of the Army of the United Kingdom, during the five years ending* 1881.

| Year. | Strength. | Ratio per 1000. | |
|---|---|---|---|
| | | Admissions. | Deaths. |
| 1877 ... ... | 16,734 | 356.7 | 24.08 |
| 1878 ... ... | 19,112 | 456.6 | 28.48 |
| 1879 ... ... | 16,867 | 478.2 | 26.86 |
| 1880 ... ... | 16,125 | 477.5 | 30.28 |
| 1881 ... ... | 15,757 | 409.9 | 24.37 |

*Statement* (13) *showing the Sickness and Mortality among the Children of the European Army of India from Eight Principal Diseases of climatic origin, during the ten years ending* 1880.

| Strength, 109,129. | | | Ratio per 1000 of Deaths to | |
|---|---|---|---|---|
| Diseases. | Admissions. | Deaths. | Admissions. | Strength. |
| Febris Intermittens ... ... | 11,930 | 88 | 7.376 | 0.806 |
| Febris Remittens et Continua ... | 8,883 | 440 | 49.549 | 4.032 |
| Dysenteria ... ... ... | 2,366 | 320 | 135.249 | 2.932 |
| Diarrhœa ... ... ... | 10,130 | 1,356 | 133.859 | 12.425 |
| Cholera ... ... ... | 390 | 287 | 735.897 | 2.629 |
| Splenitis ... ... ... | 238 | 3 | 12.604 | 0.002 |
| Hepatitis ... ... ... | 146 | 3 | 20.541 | 0.002 |
| Atrophia et Anæmia ... ... | 9,612 | 747 | 77.715 | 6.845 |
| Total ... ... ... | 43,700 | 3,244 | 74.233 | 29.726 |
| Other Diseases ... ... | 43,543 | 4,162 | 95.583 | 38.138 |
| Grand Total ... ... | 87,243 | 7,406 | 84.893 | 67.864 |

*Statement* (14) *showing the Ratios of Deaths to total Deaths from all causes, from Eight Climatic Diseases, among the Children of the European Army of India, during the ten years ending* 1880.

| Diseases. | Deaths. | Ratio of Deaths per 1000 of Total Deaths. |
|---|---|---|
| Febris Intermittens ... | 88 | 11.882 |
| Febris Remittens et Continua | 440 | 59.411 |
| Dysenteria ... ... | 320 | 43.208 |
| Diarrhœa ... ... | 1,356 | 183.364 |
| Cholera ... ... ... | 287 | 38.752 |
| Splenitis ... ... ... | 3 | 0.405 |
| Hepatitis ... ... ... | 3 | 0.405 |
| Atrophia et Anæmia ... | 747 | 100.864 |
| Total ... ... | 3,244 | 438.023 |
| Other Diseases ... ... | 4,162 | 561.977 |
| Grand Total ... ... | 7,406 | 999.000 |

*Statement* (15) *showing the Admissions and Deaths from a few other Diseases, to which in the main Children are specially liable, among the Children of the European Army of India, during the ten years ending* 1880.

| Strength, 109,129. | | | Ratio per 1000 of Deaths to | |
|---|---|---|---|---|
| Diseases. | Admissions. | Deaths. | Admissions. | Strength. |
| Tubercular Disease ... ... | 903 | 377 | 362.126 | 3.454 |
| Heat Asphyxia ... ... | 93 | 42 | 451.613 | 0.384 |
| Meningitis and Hydrocephalus ... | 337 | 231 | 685.459 | 2.116 |
| Convulsions ... ... ... | 1,682 | 1,237 | 735.434 | 11.355 |
| Dentition ... ... ... | 4,461 | 757 | 169.692 | 6.936 |
| Total ... ... ... | 7,476 | 2,644 | 346.974 | 24.228 |

*Statement* (16) *showing the Ratio of Deaths to total Deaths from all causes from each of the Five Diseases to which children are in the main specially liable, among the Children of the European Army of India, during the ten years ending* 1880.

| Total deaths from all causes, 7,406 | | |
|---|---|---|
| Diseases. | Deaths. | Ratio of Deaths per 1000 of Total Deaths. |
| Tubercular Disease ... | 377 | 50.904 |
| Heat Asphyxia ... ... | 42 | 5.671 |
| Meningitis and Hydrocephalus | 231 | 31.190 |
| Convulsions ... ... | 1,237 | 167 026 |
| Dentition ... ... | 757 | 102.214 |
| Total ... ... | 2,644 | 357.007 |

*Statement* (17) *showing the Mortality among the Children of the European Army, at different ages, during* 1877, 1878, 1879, *and* 1880.

| Ages. | Ratio of Deaths per 1000 of strength during— | | | |
|---|---|---|---|---|
| | 1877. | 1878. | 1879. | 1880. |
| Under 6 months ... ... | 244.65 | 295.39 | 319.63 | 290.73 |
| Between 6 months and 1 year ... | 158.73 | 218.75 | 216.98 | 210 31 |
| „ 12 „ and 18 months ... | 137.45 | 210.00 | 245.16 | 181.16 |
| „ 18 „ and 2 years ... | 55.87 | 141.59 | 103.26 | 94.66 |
| „ 2 years and 3 years ... | 45.63 | 71.58 | 118.75 | 55.72 |
| „ 3 „ 4 „ ... | 18.34 | 39.34 | 36.27 | 51.45 |
| „ 4 „ 5 „ ... | 16.72 | 23.28 | 40.71 | 32.47 |
| From birth to end of 5th year ... | 87.49 | 135.10 | 138.03 | 116.68 |
| „ 6th year to end of 10th year ... | 10.06 | 12.08 | 16.72 | 11.87 |
| „ 11th to end of 15th year ... | 6.41 | 8.05 | 9.74 | 6.29 |

*Statement* (18) *in which the Mortality among Children in India and England, at different ages, is contrasted.*

| Ages. | | Ratio of Deaths per 1000 of strength during— | | | |
|---|---|---|---|---|---|
| | | 1877. | 1878. | 1879. | 1880. |
| 0—5 | India ... ... | 87.49 | 135.10 | 138.03 | 116.68 |
| | England ... | 58.8 | 66.2 | 58.2 | 64.4 |
| 5—10 | India ... ... | 10.06 | 12.08 | 16.72 | 11.87 |
| | England ... | 3.6 | 3.7 | 3.4 | 3.3 |
| 10—15 | India ... ... | 6.41 | 8.05 | 9.74 | 6.29 |
| | England ... | 5.1 | 5.1 | 4.9 | 4.8 |

# ON THE SO-CALLED EPIDEMICS OF SEAMEN, MORE PARTICULARLY WITH REFERENCE TO FEVERS.

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In the last century fever, flux, and scurvy were characterised by those eminent naval physicians, Lind and Blanc, as "The Epidemics of the Sea". They discerned that, by the enforcement of sanitary measures, these diseases were susceptible of prevention and of mitigation in type, frequency, and extent, whilst the vulgar opinion was entertained of their being inseparable from life in ships. Of them, scurvy was the most widely diffused, and the least fatal of the group, on account of the almost certainty of its cure under proper treatment. Fevers and fluxes were about equally fatal, relatively to their frequency, and they were more or less intensified by the degree of the scorbutic diathesis prevalent amongst the crews.

I propose to sketch in this paper the general history of the fevers that have inflicted great losses on the English navy, and to do this without pretension to scientific exactness, as there is but little of any statistical value relating to the health of the navy in the last, and only patches of such as can be relied on in the present century, to guide and to confirm in this investigation.

The English Royal Navy for war purposes dates from the reign of Henry VIII, but we have no historical mention of any epidemic fevers in any of its ships or squadrons earlier than the reign of Queen Elizabeth. The first instance on record is that of the disaster to the squadron of Sir F. Drake in 1585-6; when, out of 2,300 men, 750 perished by fever, owing to which, after capturing and ransoming St. Jago de Cuba, S. Domingo, and Carthagena, he was compelled to return homewards. This epidemic was one of yellow-fever, which, as generally reported, was unseen by the Spaniards prior to their erecting towns on the coast.

In 1594 Drake, with Hawkins, prevailed on Queen Elizabeth to fit out a second expedition to recapture the places he

had taken with ease in 1585, but then they found extreme difficulties by reason of their being fortified with stone walls; and the troops and seamen attacking these from the shore fell victims to the epidemic fevers, compelling their re-embarkation without success. Both these gallant commanders died of chagrin, if not of fever, and the wasted expedition found its way to England. Sir Wm. Monson, in his *Naval Tracts*, writes thus: "Sir Francis Drake, who was wont to rule Fortune, finding his errors, and the difference between the present strength of the Indies, and what it was when he first knew it, grew melancholy upon this disappointment, fell sick, and died," after Hawkins had succumbed.

These were failures of expeditions of offence against the Spaniards dependent in the first degree on disease, but in the interval between them there was a far greater national effort called for in defence of our own shores against the Spanish Armada—the grandest expedition that ever left its own coasts in the certain hope of conquering another country. Our own naval resources were infinitely smaller than those of the would-be invaders; but, by the bravery of our seamen, the enemy was kept from our shores, and fought step by step as they neared them, until, as our Queen stamped on her medals, "God blew on them and they were scattered." Our own seamen withstood the weather better than their human enemy, but they were unable to stand up against a more deadly enemy, disease, the result of insufficient and bad food. Fever and flux had dwelt with them long before the enemy hove in sight. Nevertheless, they proved faithful to their calling, and took to the sea with food to last but for a few days on board, and chased the Armada to the northernmost limit of the English coast, when they were forced to return southwards without food for themselves or ammunition to render further delay at sea of value, if it had been possible. But it was not so, for as they neared the mouth of the Thames, an avant-courier, the Earl of Cumberland, brought news that the ships were all sickly, and "the admiral-in-chief was reduced to eat beans, and some of the men to drink their own water". After being ten days from the Downs on short allowance of victuals, with starvation threatening them, they sighted the North Foreland and got into Margate Roads, but the hoped-for victualling ships were not there. The infectious fever, typhus, still increasing in the sick crews, and other ships taking it from them, when it was more than ever desirable to have the fleet ready again for sea, for it was believed that the Armada would return; and that the Duke of Parma would seize the opportunity to

bring over his army from Flanders. Then it was that the undaunted queen went to Tilbury to animate the trained bands of London, sent there in haste "without a loaf or a barrel of beer provided to support them in so long a march in July". Still the soldiers felt the fleet to be the chief reliance, while there it lay in Margate Roads a thing to be avoided, and so reduced in strength that six of the ships were unable to lift their anchors. The worst of the sick were carried on shore at Margate, and as many as could be were sheltered in barns and such-like places, while the less fortunate were left to perish in the streets of contagious typhus, from want and misery while at sea. Fortunately the Armada, remembering what they had received in the onset, did not turn back in their flight; and public faith was restored only when the news came that the forces of Parma were falling back on Brussels.

In a medical view there is something to mar the glory of success on that grand occasion, for there had been ample time, before the Spaniards came, to set the house in order; and yet these sufferings will through all ages tell of the stuff our sailors of the sixteenth century were made of, whom neither the great caracks of Spain, over-towering their small barks, nor semi-starvation, nor infectious fever, sufficed to intimidate from their duty to their country.

It would have been a happy result if these early lessons had taught those in direction of our naval affairs how much the national success in naval wars was dependent on the care taken of the health of the crews; but, in fact, the one great success in driving off the invaders without their once touching the land they came to subdue, seems to have overlaid every other consideration. As we shall find hereafter, the same causes, the supply of inferior and deficient victuals, together with want of care in preventing the introduction of the germs of disease into ships, have been the reasons, operating through two centuries, that have produced failure of many great expeditions on which the nation had set its ardent hopes.

Drake was the first of our great naval commanders with experience of epidemic yellow-fever in the West Indies and typhus and dysentery in the British seas. There is evidence extant of the care he thought necessary in providing for the wants of the sick, when fever and flux broke out in the ships at Plymouth in June 1588; for it was he who advised Lord Howard to purchase wine and rice for the sick, for which the parsimonious queen refused to pay. Again, in 1589, when he and Sir John Norris were commissioned on

an expedition to the Peninsula, warned by the afflictions of the previous year, we find in his expense-book of the expedition, that before sailing from Plymouth, he made provision to meet contingencies of disease. "For sundry provisions for physic and surgeons, with money imprested to physicians and surgeons, £253 15*s*. There is taken in this town by me and Sir J. Norreys, Kt., 300 butts of wine, for the which we have given our bills, to be paid at our return from the services." Doubtless the bills were duly honoured, as the expedition brought back many prizes; but even after such foresight he had to write to the Privy Council, when occupying the suburbs of Lisbon, "Both soldiers and mariners are suffering from extreme sickness."

A much better fate awaited the expedition to Cadiz, under Lord High Admiral Howard and the Earl of Essex in 1526. It was nine weeks absent from Plymouth, and returned in perfect health, "as the like has not been seen, for so many to go out of England on so great an enterprise, and to return home again so well." With this exception, the list of great naval expeditions, until the middle of the seventeenth century, was a succession of naval failures or disasters, on account of sickness. The year 1625 was peculiarly so in two instances. It was the last year of king James the First's reign, when the plague was epidemic in London. The king, urged on by his people to take part in the Thirty Years War, allowed an army of 12,000 volunteers, under Count Mansfeldt, to embark. The expedition reached the coast of Holland with the plague epidemic amongst them. They did not land, but the corpses being cast into the sea, the camp was infected thereby, and sustained heavy loses, and the few remaining English returned to London. In the same year a grand expedition, without a hospital ship, was sent to Cadiz under the Earl of Essex and Lord Wimbledon. It failed in its purpose owing to the outbreak of typhus in the camp; and, on re-embarking, the sick were distributed throughout the fleet, which spread a general infection, so that the ships with difficulty reached their home ports. It is worth noting here, that in ten days after their departure from the shores of England, the plague was reported to be in the ship commanded by Sir William Ledger. Again, in the unfortunate expedition of 1626, under the Duke of Buckingham, Lord High Admiral, the sickness from fever was so great as to lead to reembarkation without relieving Rochelle, which they had gone forth to effect. It may be accepted as a fact that sickness by fever baffled the commanders more than the enemy did, and caused disastrous failures on so many occasions.

If we inquire into the causes of the bad sanitary state pre-

vailing then, we find these summed up by Admiral Sir William Monson, a contemporary admiral, in "official corruption, which profited by the baseness of the contractors for the victualling in supplying stinking and rotten articles of food, and in the deficient weights in issues made by the pursers of the ships"; and he openly asserts that their unlawful gains were made by "deceiving the king and the ship's company; for the pursers' unseasonable griping of the men's bellies makes them weak, sick, and feeble, and then follows an infection; whereas the king allows, and pays for, a large and sufficient rate for every man's diet." In these words of a competent observer we are taught that the same dietetic causes operated injuriously on the health of King Charles's seamen as on those of Queen Elizabeth, and we may trace them onward in operation to a much later date; for the victualling of the navy, so long as it lay in the hands of private individuals, was ever a prolific source of riches to them, and of harm to the seamen.

We have now arrived at a point to gain some knowledge of the character of the fevers at that time existent, from the pen of Mr. John Woodall, Master of Chirurgery, and Surgeon of St. Bartholomew's Hospital, whom I regard as the father of English nautical medicine, since he is the first author on its specialities, and the earliest professional writer on the use of lemon juice as an antiscorbutic-prophylactic and remedial, of which he had experience in the early voyages of the East India Company. Being selected to superintend the appointments of its surgeons' mates, and the provision of medical and surgical chests, it fell within his province to write out instructions for the mates, to guide them in their medical duties, which were quite new to them as barber-surgeons, since on shore, in those times, they were not permitted to prescribe drugs, the right of physicians only; while in their occupation at sea, they had, from necessity, to act as general practitioners in surgery and medicine. It may, indeed, well have been that those who practised at sea, and in the army, were the men who introduced that combination into general use on shore, for the right so to practice was conferred upon them, and respected until the Medical Act of 1858. Mr. Woodall, in 1615, printed in a volume the instructions he had been accustomed to write out, and modestly entitled it *The Surgeons-Mate or Viaticum*, in which he described the treatment of "the scurvy, the fluxes of the belly, the colic, iliac passion, tenesmus, prolapsus ani, the calenture," etc.

Later on, however, when the Duke of Buckingham was engaged in preparing naval armaments, about 1624, Mr. Woodall was selected to act for the Royal Navy on the same

lines as he had been accustomed to do for the East India Company's service; and thus, in 1629, he brought out an enlarged edition of his work dedicated to King Charles. In that volume he added a dissertation on the Plague, possibly actuated to do so on account of the occurrence of that disease in armaments at sea in 1625. His definition and treatment of fever are thus given:—"A heat in the heart more than natural, infected, and dispersed through the whole body, whose treatment is by purging, bleeding, and good government"—in which he evidently alludes to inflammatory fevers in general. He then introduces the Calenture, derived from the Spanish language, meaning fever; and it may be inferred that the sea surgeons, in dealing with that in which the Spaniards were more skilled than themselves, adopted with the name the Spanish treatment of the disease. He writes thus concerning it:—"By all my experience, or what I can gather from others, the calenture is no other thing than a contagious fever; for the most part suddenly assaulting seamen, sometimes it is with paroxysms, sometimes continues, and hath its fits—hot and cold—in some, and that very violent, even to the loss of senses." We may conceive that in this lie embraced all the fevers of hotter climes than our own, and that the Spaniards, more familiar, at the time, than we were with the pernicious agues, the bilious remitting, and the yellow fevers of their colonial possessions, east and west, classed them all "*calentura*". The treatment ordered differed widely from the depletory measures directed in the ardent fever; it was to be "alexipharmics and cordials, by brandy and other stimulants, that the animal, vital, and natural parts may be defended from the venomous danger of the disease; and in evacuation, and regimen of diet; all these being as suddenly put in practice as time will serve, the disease being sudden and fierce in itself, repeating the same, then evacuation by a glyster or suppository; and after its action a moderate abstraction of blood, low liquid diet, and after two or three days in the name of God give him a dose of laudanum, and you shall find it often to procure health without further help." "The vital force is to be nursed; for over-purging, bleeding, and much thin diet, will be very dangerous at sea, and will surely turn into the scurvy. For note this for a general rule, that almost every sickness at sea ends in the scurvy; and the scurvy oftimes unlodes itself by a flux, with death attending thereon." We can only admire these very rational directions, that were adopted from the Spaniards, which, no doubt, subsisted until the value of bark was made known in Europe by the Duchess of Cinchon. I would remark that this treat-

ment resembles closely in its principles that recommended by our own Hippocrates—the great Sydenham, in the first edition, 1666, of his *Medical Observations for the Treatment of Typhus.*

I have dilated on the writings of Woodall because they mark the progressive advance of nautical medicine in the writings of a surgeon far beyond his age; and I can but think that if his views had been at once adopted, our own navy would have been spared the loss of, at least, 50,000 lives, most valuable to the nation, through the seventeenth and eighteenth centuries, since which the voice of practitioners experienced at sea has been listened to by those holding authority over naval affairs, with miraculous results in the saving of the lives of seamen. Till the reign of Charles the First, the Crown appears not to have concerned itself, or to have acknowledged any responsibility, about the sick of the navy after discharge from its ships; in which it disregarded the existing rules of all mercantile communities, on the theory that a fleet was only an army embarked, of which the persons and the materials were to be put away as soon as found unserviceable; and, therefore, sick seamen were treated as sick soldiers were. The whole tenor and course of Queen Elizabeth's behaviour towards them is explicable only on this principle, that the seamen's wages and daily victuals were the reward for the day's work, and as to medicines and medical comforts, and lodgings on shore when sick, they were themselves to "acquit them, or to suffer, and die."

Up to the period of the Commonwealth there was no further enterprise at sea; and then, in 1652, came the first war with Holland, in which the first fight with Van Tromp was, at best, a drawn battle, in November 1653. This brought to the mind of Parliament the absolute necessity to "provide for the encouragement of seamen", which was done at once in a series of resolutions—"to increase their pay; to give every six months' service at sea the allowance of five pounds for every hundred men; to direct the municipalities in port towns to take care of all necessary accommodation, at the charge of the State, for the relief and cure of such sick and wounded seamen as shall be sent on shore; to establish for the same purpose an hospital, at or near Dover, Deal, or Sandwich; to use, for the wounded in the sea service, one moiety of the accommodation in all hospitals in England, for the cure of sick and wounded people; to devote the tenths of all prizes, taken or to be taken, customary to the Lord High Admiral, to defray the charges of sick and wounded men, and for the relief of widows, children, and impotent parents of those

slain at sea, and for medals or rewards, to such officers and seamen as shall be found to have done any eminent or extraordinary services." These were revolutionary concessions; to which was added, at the same time, greater attention to furnishing sound victuals to the navy; and thus satisfaction was given to the men who were to fight the country's battles, the results of which were shown in the victory of Blake over the Dutch fleet in February 1653, in which Blake was severely wounded.

After that victory our fleet returned to Portsmouth, and the sick and wounded were put on shore at Cowes, Portsmouth, Gosport, and Fareham; fever of an infectious nature being the prevalent disorder. Dr. Whistler, with an assistant physician, was sent to Portsmouth to ensure proper attendance on the sick, and, in his first report to the Admiralty Committee, Dr. Whistler stated that "the houses of Portsmouth were full, and there being some malignity in the sick that might endanger the garrison, it was proposed to use Portchester Castle for an hospital. We have been at great expense in providing for them, and the seven shillings a-week formerly allowed will not suffice." The fleet under Blake being restored to health, quickly returned to sea, and gained, in June, another victory off the Texel; then, negotiations were thought of, and another victory in July, by Monk, in which Van Tromp was slain, caused the Dutch to sue for peace.

So much followed on the resolutions of Parliament for the encouragement of seamen, that the relationship of cause and effect can scarely be denied to the events. As the Dutch calculated their losses in prizes taken at £6,000,000 sterling, of which the tenth, in Admirality droits, was allowed by the resolutions, there was a large fund for providing for the sick and wounded sent ashore; and from the dread of contagion extending to the garrison of Portsmouth, we may infer that the sickness landed from Blake's fleet was typhus fever.

The disasters from fever at St. Domingo under Penn and Venables in 1655, were worse than those under Sir Francis Drake in 1585.

At the Restoration the office of Lord High Admiral was restored in the person of the Duke of York, and of course, together with the old office all its droits were restored, including the tenth of all prize-money, which had been voted by Parliament for the care of sick and wounded seamen.

When a war with the Dutch became again inevitable, quite a new plan was instituted for that duty, and organised three months previous to the Declaration of War, the King

and the Lord High Admiral taking personal interest in the matter. Commissioners for sick and wounded and prisoners were then first instituted, as president of which the philanthropist and philosopher—Mr. John Evelyn—was appointed by the King, and therefore it may be inferred that the duty was well performed. Among the *Additional Manuscripts* in the British Museum, 5752, Plutarch 184H, there is a copy of the instructions, dated 1672. These were admirable in their details. Power was given to send direct from their ships into the hospitals of London, "to ease His Majesty's charges"; to form depôts at all the main seaports on the coasts of Essex, Kent, Hampshire, and Devonshire; to appoint to each a physician (if need be), a surgeon and nurses, and to supply fire, candles, linen, medicaments, and other things necessary for the relief and cure of such sick and wounded men; and for the decent interments of those who may die, to discharge the expenses of the same. On an engagement taking place the Commissioner of the district was to proceed to the nearest port towns, to see that the instructions were carried out; and then was to testify to the Navy Boards, the conditions and damage of the wounded men for their proportionable relief out of the Chatham Chest—which was another means of easing His Majesty's charges; and he was to report the condition of the widows, children, impotent parents of such as fall in the action, and to give them gratuities not exceeding £10, and to report any extraordinary case to the Duke of York. All necessary moneys were to be obtained from the Treasurer of the Navy. This was a recast nearly of the Parliamentary resolutions. This organisation was at first intended to be in force only while a war lasted, but after the Revolution, the Board or office became permanent through the 18th century, and into the 19th century. In the *Diary and Correspondence* of Mr. Evelyn, there is a running description of how the new system worked in his hands, his great and persistent difficulty being the procuring of money from the Treasurer of the Navy to meet the current expenses, throughout the second and third wars with Holland. In his letters to Lord Cornbery, Sir Philip Warwick, and Sir William Coventry, in September and October 1665, there are indignant remonstrances at the position in which the Commissioners stood from the want of funds.

In the letters and diary of Mr. Evelyn, there is no allusion to the numbers of sick and wounded sent on shore; but from the amount of costs incurred in their maintenance it is very clear that their numbers must have far exceeded all expectations; and it may be believed that, wanting the wise

provisions of commissioners to care for them, these unfortunates being proportionately so many, their sufferings would have far exceeded those in the days of Queen Elizabeth.

It would appear that the corrupt practices had grown again in the victualling of the Navy to what they then were, as in the year 1689, the House of Commons sent for the victuallers of the Navy, in custody of the Sergeant-at-Arms, to answer a complaint attested by several Members of Parliament upon their own knowledge—"That great quantities of corrupt and unwholesome victuals had been furnished to the Navy this last summer, which had been the occasion, as most conceived, of great sickness and mortality in the fleet." That this state of affairs had been slowly gathering since the Restoration, may be inferred from a commission issued by King James II, in 1686, "to inquire into the corrupt practices in naval affairs in the later years of the reign of Charles II," that is, after he himself had resigned the office of Lord High Admiral, and the King had taken it into his own hands.

The great sickness and mortality, taking into consideration "corrupt and unwholesome victuals" as the assigned causes, may be safely attributed to fever, scurvy, and flux, the "epidemics of the Navy".

Sir Gilbert Blane, in his *Observations on the Diseases of Seamen*, p. 186, asserts that the naval expedition under Sir Charles Wheeler, was one of those frustrated by the force of disease alone. Writing at a later date, Sir Gilbert remarks, "The expedition to the West Indies, and North America, in the year 1693, consisting of two ships of the line and six frigates under Sir Francis Wheeler, miscarried in the attack on Martinique, through the force being weakened by disease; and in his voyage to England, the companies of his ships were so weakened by mortality from scurvy and fever, that they were hardly enough to bring their ships to anchor on their arrival there."

This brings to a close the history of the health of the Navy through the 17th century, which presents so many instances of expeditions frustrated by disease, the product of corrupt and unwholesome victualling, to which must be added the too frequent dissensions of the naval and military chiefs who conducted them to disaster; and the remark may be appended that the only territorial gains for all its wars and fights, was the Island of Jamaica, gained without resistance from Spain, and New Amsterdam, now New York, from the Dutch. Before proceeding, I may, however, allude to one thing closely related to this question of fevers in the Navy; and that is the introduction of cinchona bark into

Europe, as a remedy for intermittents in the first half of the 16th century. It is known that no fiercer discussion in medical circles has ever existed, than that on the merits of this remedy up to the end of the century, in spite of the approval of Dr. Sydenham, and the Regius Professor at Cambridge, when its employment was stigmatised by very many of the London physicians as the rankest of empiricism. It is pleasing to know on this point that Dr. William Cockburn—a physician of the Navy—writing, in 1696, on the treatment of fevers, stood very firmly in favour of the use of cinchona, employing nautical phraseology in his argument, thus: "But whatever may be thought of my pretended certainty, 'tis at least as well grounded as a great many maxims in the Hydrostaticks, etc., which no ship's carpenter, or man of science doubts of; but, on the contrary, finds all his calculations and inferences orderly made, to answer his expectations in his practice." This tone of argument seems to indicate that it rests on ship-experience of the value of the remedy, which however was not again written about by any naval medical man until 1771, the reason being that it was one of finance influencing the surgeons, the bark being too costly for them to provide out of the moneys given to them for filling their medicine chests. But it would have been otherwise if, at that time, the Government had provided the bark at its expense for the treatment of fevers, as, at a much earlier period, it had Dr. James's powder, which was really an empirical remedy. (Note A.)

On the 27th March 1700, Dr. Cockburn's *Proposal for the Cure of Seamen seized with Fevers in the West Indies* was transmitted by the Admiralty, through the Navy Officer, to the College of Physicians to ascertain their opinion thereon. The decision arrived at may be imagined, if Dr. Cockburn's proposal were to treat West Indian fevers with the bark of Peru. Thus, in an official mode, the important question was burked, and nomore heard of it until 1774; after which it came into use, as a gratuity, on the eulogies of its virtues, prophylactical as well as remedial, by Dr. Robinson, a naval surgeon, at first on the Bight of Benin in 1769, and not in the West Indies until 1796, nearly a century later than the recommendation of it by Dr. Cockburn.

The peace of 1697, by treaty of Ryswick, was ended in 1702, when war with France was renewed, but preparations had been made for it in 1701. It lasted until 1713. It had been prepared for as a naval war in the West Indies. Experience had taught the need of a hospital at Jamaica, and one was established there, and called Greenwich Hospital,

on the shore of the bay opposite to Port Royal; but the locality being found very malarial and productive of endemic fevers, it was, at some period, shifted to Port Royal, its present situation. Admiral Benbow was appointed to the command; and then the Admiralty disregarded Dr. Cockburn's proposal to give cinchona, and adopted the secret remedy of a Dr. Stringer, directing the Navy Office to purchase £30 worth of it, and to deliver it to Admiral Benbow, to be disposed of amongst the ships going to the West Indies. At home, Commissioners of Sick and Wounded were re-appointed on the same plan as in the preceding century, and an order was given to issue to ships in home ports, two days in the week, fresh meat in lieu of salt. An old sailor, Admiral Rooke, was then First Lord of the Admiralty, and certainly very much care was taken to provide for the sick and wounded; but, notwithstanding all, the main causes of disease lay untouched at their roots. (Note B.)

In 1702 large fleets were commissioned, and 40,000 men were voted for their crews, which were raised, as before, by impressment, and, as before, they brought infection with them. In 1704 the Commissioners of Sick and Wounded memorialised the Treasury for funds, stating that between the 1st July 1702, and 30th of June 1704, 20,844 seamen had been landed at the out-ports: the charge for quarters for them had amounted to £31,266, besides medicines, cures (6*s.* 8*d.* for each), and incidents. "The fleets coming home so sickly from foreign service, with no fighting at sea, and the expenses were double those of the last war." Up to this time the sick and wounded of the navy were lodged on the ancient principle of billeting land forces, in taverns and public-houses, where they were under no restrictions, and indulged in drink and debauchery so long as they could get money or credit; as a result the mortality was excessive, and desertions, although under pain of death, were very numerous. As the Government was not prepared to construct hospitals, they contracted with the local physicians to do this; still, through often overflowing, recourse had to be taken to the use of private houses in the town, in which the former evils soon flourished again, and became so flagrant, that in 1744 naval hospitals were ordered to be built. The disadvantageous state of the private hospital and sick-quarter system may be judged from these facts, that in six months of 1740, from April to September inclusive, there were treated at Gosport 5,331 sick, of whom 3,923 were cured, 514 died, 468 deserted, and 328 remained; giving per 1,000, 755 cured, 96 dead, 88 deserted, and 61 remaining under

treatment; the expenditure averaging £2,300 a month. On such results it was decided to build naval hospitals. The relative proportions of the diseases prevalent at that period may be accepted from the list of those admitted in one month, when out of 1,131 sick, 493 or 433 per 1,000 were fevers, 554 or 488 per 1,000 were of scurvy, leaving only 90 or 79 per 1,000 of all other diseases. In 1754 that at Haslar was in part occupied, and in 1756 that at Plymouth, with great benefit to the seamen and advantage to the Government; but Haslar was not completed as it stands at present until 1762, and Plymouth Hospital until 1765; so that in the seven years' war they were incapable of receiving all the sick from the fleets, and the sick-quarters in the towns were still in request in the war with France and Spain in 1778-82; and so far as relates to sick officers, the practice was not discontinued at Gosport before 1796.

From the commencement to the middle of the 18th century our wars gravitated towards the Spanish colonies in the West Indies and the Spanish Main, and it is almost needless to recall that most of our great expeditions against them were disastrous, in a large measure dependent on the epidemic diseases of the coast, which became epidemic when seizing on crowded, unventilated ships. These diseases were yellow fever or bilious remittent, whose malignancy was fully developed when attacking crews enfeebled in health by the preventable scorbutic diathesis, which happened repeatedly. Thus in 1726-7 Admiral Hosier went quickly to Porto-Bello, and, in the sickly season, remained there six months, when three weeks should have sufficed in so pestiferous a locality. After that they returned to Jamaica, where it was necessary to fill up their vacancies by death with new crews. Then they sailed to Carthagena, and these results recurred, so that it was again necessary to re-man the ships. Dr. Lind tells us that the cause of these calamities was scurvy, followed by endemic fevers, and completed by dysentery.

In 1741-2 Admiral Sir Chaloner Ogle and Vernon, with General Wentworth, attacked Carthagena, and after losing 600 men killed or wounded, the endemic fevers broke out amongst ill-fed men, and became general through the camp on a marshy site, so that it was necessary to re-embark and get back to Jamaica. After regaining strength, they proceeded to Cuba, from which they were compelled to re-embark from the same causes and results; for as Campbell writes in his *Naval History*:—"Their numbers were so reduced by the diseases of the climate that if they had staid another month there" (where they had staid four months

amidst malarial causes), "there would scarcely have been a man left to bring home the tale of their disasters." And he adds: "If humanity be admissible in politics, future ministers would not wantonly transport so many thousands of Europeans to a climate where it is almost impossible for them to exist. Thus ended this vast enterprise, in which ten thousand lives were sacrificed without the least benefit to the nation or glory to the commanders." He tells us, too, that in 1740, at Chagres, Admiral Vernon captured in the Custom House 4,300 bags of cinchona bark. At that time its medicinal worth and commercial value being known, it was most likely sent off at once to fetch its price in the London market; and we can only reflect with pity, that had it been judiciously retained for use, those ten thousand lives might, to a great extent, have been spared. The cinchona bark was worth more than its weight in silver to them, but if consumed by them the prize-money would have been diminished, and in those days that was a paramount question; and it may be historically recalled that, in 1625, the Earl of Essex was charged by his officers with disregard of the wants of his sick forces, in not appropriating a prize cargo of wine to their use, by which their great calamity was aggravated.

In the last half of the century there were three great wars with France—the first, 1756 to 1763, to protect our colonies; the second, 1774 to 1783, in opposing the revolt of our greatest colony; the third, 1794 to 1800, against the French Republic—each of which stood as the offspring of its predecessor. The fleets employed were greater than any before known, and the diseases experienced by them were still very destructive of men.

In modern history this period has proved to have been the most important in civilisation, as it altered the destiny of all of North America and India, and established the future for them, inasmuch as the chief foreign possessions of France fell under the dominion of England, making her the first of colonial powers and mistress of the ocean.

I have adverted to the waste of life in the West Indies in the first half of the century, which in the second half was mitigated by improved dietary, and by attention to the cleanliness of seamen as well as the ventilation of ships. It is curious to observe how slowly the practice of ventilation grew into repute amongst naval commanders, owing to the bulkiness of the machine provided for it, and to the amount of extra labour demanded for its working. To cure this supineness an order was issued in 1747 to this effect:

"Captains in general not understanding the proper use of these machines, they are hereby strictly required and directed to cause them to be made use of, at least one half hour in every watch (*i.e.*, four hours daily), and the mate of the watch to note in the log-book the time of its being so made use of." But the prejudice against the contrivance was not overcome. The first ship to which it was fitted was the *Captain*, of 70 guns, in 1742; and in 1758 the inventor, Dr. Hales, F.R.S., wrote: "Knowing that they were received with coolness by some, and with contempt by others, I have reason to suspect that they were very little used, and not with the proper precautions as to make the ventilation the most extensively beneficial to the greatest part of the ship, which is best done by shutting all the hatches of the lower deck during the ventilation at sea." I think that the strongest evidence of the dislike, from the inconvenience of this plan, is in the fact that the most practical and successful of all naval sanitarians, Captain James Cook, declined to have his ship so fitted. In his first voyage his crew were enduring all the causes of scurvy, on the coasts of New Zealand and Australia, from October 1769 till August 1770, when they became exposed to the malaria of the Eastern Archipelago, and lost 36 per cent. of crew by fevers. Profiting by experience, in his second voyage of three years he returned with a loss by disease of one man, for which the Royal Society rewarded him with the Copby Medal.

Rules for observing cleanliness of the ships and crews were printed in 1747 also, amongst which is this, that all the men on board, whether new raised or others, were to be seen as to the cleanliness of their persons and clothing. Sir G. Blane stated his opinion that the great improvement in the health of the navy between 1790 and 1810 was assignable, amongst other reasons, to the greater attention bestowed on the better observance of cleanliness, ventilation, dryness, and sobriety, the neglect of which he had represented to the Admiralty in 1781. And writing thirty years later, he states:—"And with regard to fevers, they have been extinguished by watchful attention to these points as one of the most sacred and indispensable duties of commanding officers." It is difficult to imagine how cleanliness of person or of clothing can be maintained without the use of soap, with an abundant supply of fresh water for that purpose, and it is noticed by Sir John Pringle that Captain Cook had great attention paid to that matter also. Sir G. Blane states that he suggested the supply of soap, in 1781, to seamen in health as well as when sick, and that it was then granted gratui-

tously to the sick, at half a pound per week per man, but was not supplied to the healthy till 1796, on the application of Lord St. Vincent. He was convinced that cleanliness in person and clothes would be as sure a preventive of the infectious ship fever as lime juice had been of scurvy.

We possess some excellent authorities on types and characteristics of the fevers in our fleets in the eighteenth century. These are: Dr. Huxham, at Plymouth, from 1735 to 1745; Dr. Lind, of Haslar Hospital, from 1754 to 1775; Dr. Robertson, from 1760 to 1777; Sir G. Blane, from 1780 to 1783; and Dr. Trotter, physician of the Channel Fleet, 1794 to 1804.

At home the fevers were contagious adynamic typhus, known as "Ship and Jail fever", which had been known as Jail fever in England since 1572. Its highly infectious nature had displayed itself on several occasions, at various assizes, when judges, juries, and audiences had become infected in court by prisoners at the bar, who, without having fever themselves, were brought from their filthy dens, with their clothing saturated with the effluvia and corrupt matter imbibed there. The same results followed in our fleets, when wars were in their course, and impressed men and prisoners from the jails were sent to the fleets fitting out at the ports, often wearing the garments they had had on their persons for weeks and even for months. So that among them direct causations of typhus were conveyed on board, and disseminated from ship to ship. This was the English fever, that was thus conveyed in newly commissioned ships to distant stations, as to the coasts of Spain and the Mediterranean, to the West Indies, where it died out rapidly, or gave way to endemic fevers of the remitting, the yellow, and the intermittent types. When carried to the more temperate climate of North America from England, it would seem to have undergone change by the influence of malaria, by which it took on a composite form of a typhous or adynamic bilious remittent fever, with yellow skin, without black vomit however, in which type it was brought back to England. Dr. Lind shows it to have been infectious when brought from North America to Haslar in the wars of 1756-63; and that, in the same period, the town of Brest and its vicinity were almost depopulated by the fever, on the return of the fleet, that having had the ship and jail typhus on board on leaving France returned home within six months totally disabled by the composite type of fever, which had been brought back in our own fleet, although they had never met. From improved habits of cleanliness of the persons of the seamen, and with it improved ventilation of the ships, this type became milder by degrees; but, according to

Dr. Trotter, it was occasionally conveyed into ships by the new levies of men; but it had lost its infectiousness at the end of the last century, owing to the careful attention to the segregation of these men from others, and to the new practice of isolating the sick from the healthy. All of these fevers were in reality the product of the shore conveyed into ships and fleets, and only to be freed from their infectious qualities by fumigation.

In the same manner the plague itself was introduced in two instances; in 1623, becoming epidemic in one crowded with a legion raised from the scum of London, where the plague was epidemic. It was fortunate that the plague did not attack our fleet in the Downs in 1666, when it was so terribly epidemic in London.

The fevers endemic in the West Indies—the yellow and bilious remitting—caused terrible ravages in our fleets sent there, from the beginning to the end of the last century. It was rarely, if ever, a fleet went from England to that station, without forming an epidemic centre in itself, if none existed elsewhere at the time; and, in the first half of the century, many expeditions failed entirely owing to sickness by endemic fevers. So late as 1794, as recorded, the fleet and army, under Admiral Jervis and Sir Charles Grey, engaged in the reduction of the French island, suffered very much from the West Indian fevers, wanting the only preventive treatment. In 1804, it is stated by Dr. Trotter, typhus fever was conveyed by the impressed men from the slums of London, into the ships fitting for sea at the outports. These instances indicate that the experiences of the eighteenth century were not practically formulated and in action at its end. The French gave the name of "The Seamen's Pest" to it, while our sailors familiarly spoke of it as "Yellow Jack", believing that no means could keep it away, and that it was an unavoidable destiny, and happy were those exempted by a previous attack.

Like typhus, the eruptive fevers were often introduced from the shore, and it is surprising to read now, how very calmly such events were regarded in those days. Vaccination was ordered early in the present century, before 1806, when it is first found in the surgeon's instructions. Of this eventful period, Dr. Robertson informs us that at the capture of the Havanna in 1762, thousands of lives were sacrificed for want of bark chiefly, that is to say, they perished of fevers. "A period, therefore", he adds, " which, for the mortality both of seamen and soldiers, will be memorable throughout His Majesty's dominions for many ages. There was a general want of bark

both in the fleet and army, when they were very sickly, until, providentially, a capture of a large quantity thereof was made in one of the enemy's ships, which was carefully divided between the fleet and the army." Lord Albemarle commanded the land forces, and Admiral Pocock the fleet; and with regard to the cargo of bark, their discretion contrasts well with that of Admiral Sir Chaloner Ogle and General Wentworth, at Chagres, in 1740.

Sir Gilbert Blane affirms that in the fleet of Admiral Rodney, in three years there died of diseases 3,200 men; and of them 1,518 out of 12,109 men, or 124 per 1,000 in a single year, who, being saved, would have sufficed to man two line-of-battle ships. Further, that during that war, to the foreign naval hospitals from Gibraltar to New York, and Barbadoes—seven in number—there were admitted 45,018 sick, of whom 6,449, or 121 per thousand, died; the mortality being greatest at Barbadoes, Jamaica, and the West Indies generally, the total mortality there being 176 per 1,000 cases. In a memorable Report to the Commission of Sick and Wounded, he earnestly suggested, in 1781, attention to the cleanliness and dryness of ships, and the cleanliness of the seamen, the supply of antiscorbutics generally, that of necessary comforts to the sick, the gratuitous supply of cinchona, etc. Fever, flux, and scurvy were still the pests of that malign station, but with less force than in previous wars, and his teachings concerning their prevention were soon laid aside, or not fully acted up to, since the use of bark as a prophylactic from fever was not allowed on that station, as it was on the Coast of Africa until 1796, although Robertson had proved its usefulness at St. Thomas's Island in 1772, and Blane had strongly urged the necessity for its use in 1781.

Statistics are applied fully to the study of diseases in the age we live in; the only standard we possess of the state of naval medicine in the last century is owing to the great assiduity, and love of the service, that actuated Sir Gilbert Blane, when a member of the Sick and Hurt Office, 1795 to 1799. In his *Observations on the Diseases of Seamen*, third edition, 1799, page 174, we find a table giving the admissions and mortality through forty years, between 1755 and 1793, at Haslar and Plymouth Hospitals, which afford these summaries.

| | Admissions. | Deaths. | Ratios per 1000. | Difference. |
|---|---|---|---|---|
| At Haslar ... ... | 176,390 | 9,429 | 53.4 | 5 in favour of Plymouth. |
| At Plymouth ... ... | 111,634 | 5,424 | 48.5 | |
| Total ... ... | 288,024 | 14,853 | 51.5 | |

This forms a standard of the general mortality in gross from all causes in our great naval hospitals at home, and, so far as it goes, we may now compare with it the mortality of the middle of the present century in the same edifices, that have received most of the modern nosocomial improvements and structural reforms, so far as they have been compatible and convenient.

We are now provided with annual records of the State of Health of the Navy, the credit of the inauguration of which is due to the late Sir William Burnett. Of these there are two series, the first from 1830 to 1836, of which no use can be made on our topic, as in it all fevers, "Continued, Remittent, and Intermittent", form one group. The second series is continuous from 1856 to the year 1882; but it is not easy to work them as one complete series, because it does not present a uniform classification of fever throughout; thus, at first yellow fever was not separated from the other, and, until 1869, continued and remittent fevers were classified as one form of disease. In 1869, the new nosology of the Royal College of Physicians was adopted for classification with most satisfactory results; and for ten years, from 1869-78, there is a very valuable series of statistics, in which medical officers will always find at hand safe data for their guidance. In 1879 a change was made in grouping fevers, as eruptive, continued, yellow, and paroxysmal; and in which of these groups, typhus, enteric, relapsing, and remittent fevers are placed is uncertain, as they are not differentiated as before; and thus the classification of fevers has relapsed nearly to what, for statistical purposes, it was in 1836.

On a careful digest of the nosological tables of diseases, the total force distributed over the world, from 1859 to 1878, to ascertain the mean duration in days, and the mortality per 1,000 men, they may be best presented in tabular form, thus:—

| Fevers. | No. of Years. | No. of Attacks. | Days under Treatment. | No. of Deaths. | Death ratio per 1000 cases. |
|---|---|---|---|---|---|
| Simple Continued and Remitting combined | 10 | 35,214 | 13.8 | 687 | 19.5 |
| Simple Continued ... | 10 | 14,827 | 10. | 42 | 2.16 |
| Remitting ... ... | 10 | 5,420 | 18. | 96 | 17.5 |
| Intermittent ... ... | 20 | 17,889 | 10.5 | 13 | 0.76 |
| Yellow ... ... | 20 | 1,374 | 14.2 | 616 | 451. |
| Typhus ... ... | 10 | 54 | 33.2 | 14 | 259. |
| Relapsing ... ... | 10 | 16 | 31. | 1 | .06 |
| Enteric ... ... | 10 | 602 | 55.5 | 172 | 285. |

Through the first term of ten years simple continued and remittent fevers were classed together; and, in the second,

they were separated; and, as results, the relative values in duration and mortality between these types of fevers, the one arising from general, and the other from special endemic causations, are arrived at. The subsequent groups of fever arising from specific causes, embracing endemic, infectious, and contagious types, are interesting in so far as they display the comparative ratios of duration, and mortality, from which the differences in severity, and the amenability to treatment at present existing among them, may be estimated.

The latest Statistical Report of the Health of the Navy for 1881 shows that with 14,400 men employed, the average ratios, per 1,000 men, for ten years, including 1871-1880, are as follows:—

| | Cases. | Invalided. | Dead. | To Mean Force. |
|---|---|---|---|---|
| Eruptive Fevers ... ... | 5.59 | .01 | .14 | Per 1000 men |
| Continued „ ... ... | 35.56 | .25 | .55 | „ |
| Yellow „ ... ... | .33 | — | .14 | „ |
| Paroxysmal „ ... ... | 23.33 | 1.38 | .25 | „ |

This table, while affording no information, except for the yellow fever, on any of the different types of eruptive, continued, remittent and intermittent fevers, gives at first sight a very satisfactory health state of the Navy, which has gone on improving from the first appearance of annual reports on it; which is, to my mind, a strong testimony to the importance of the light thrown on the subject through these reports, wherein the medical officers have had, up to the year 1879, an authorised way of making known what have been in their opinions the reasons for any deviation from the standard of health within their own official circle. It may be hoped that under the present guidance of the department, there will be restored in some degree the facilities under which the utility of the medical naval service has of late made such great strides in the science of sanitation in fleets and hospitals.

The present century has been the arena of vast improvements, structural, social and disciplinary, in the Royal Navy. After all that may be learned of the state of health prevailing in previous ages, which was often regarded as an ineradicable condition that must be endured, and of the resistance offered from that groundless sentiment, especially where an increased expenditure stood in the way, it is pleasing to know that an entirely new feeling is now in force, viz., that prevention is better than cure—which has been the incentive to those improvements of social and disciplinary character that have raised the moral tone of seamen—and with it the

physical strength to resist diseases has been greatly developed.

May we not confidently trust that the new system, that has proved so beneficial, will be fostered in whatever direction other benefits may be fairly expected to arise.

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## APPENDIX.

### NOTE A.

Dr. Trotter, who, after serving in Haslar Hospital, was the physician in Lord Howe's fleet, states in his *Medicina Nautica,* "that while twenty guineas per day has been expended at Haslar Hospital on James's powder during a long war, yet such a delicacy as a piece of roasted meat, a pudding, a jelly, or a custard, has never been seen within those walls." To which he adds:—"Those physicians who think to cure diseases which spring from misery and want, without nourishment and support, must have an unbounded confidence in the wonder-working power of medicines."

### NOTE B.

It was in contemplation in 1702 to make provision of medical comforts for the sick in ships of war. This is manifest from a MS. to be seen in the British Museum Library, vol. 5430; Plutarch 5430, fol. 105 b. A.D. 1702 (docketed) "Surgeons' necessaries for 40,000 men for twelve months. —An Estimate."

| Necessaries. | Price. | Quantity. | Summe. | | |
|---|---|---|---|---|---|
| | | | £ | s. | d. |
| Sugar (brown) ..... | 6¾*d.* lb. | 48,000 lb. | 1,350 | 0 | 0 |
| „ (white) ..... | 10½*d.* „ | 19,200 „ | 840 | 0 | 0 |
| Rice ..... | 5*d.* „ | 14,400 „ | 300 | 0 | 0 |
| Barley ..... | 3*d.* „ | 14,400 „ | 180 | 0 | 0 |
| Currants ..... | 7½*d.* „ | 19,200 „ | 600 | 0 | 0 |
| Raisons of the Sun ..... | 4*d.* „ | 9,600 „ | 160 | 0 | 0 |
| Tamarinds ..... | 1*s.* 4*d.* „ | 1,200 „ | 80 | 0 | 0 |
| Nutmegs ..... | 7½*d.* oz. | 2,400 oz. | 75 | 0 | 0 |
| Mace ..... | 1*s.* 9*d.* „ | 2,400 „ | 210 | 0 | 0 |
| Cinnamon ..... | 7*d.* „ | 2,400 „ | 70 | 0 | 0 |
| Box and Cord ..... | 3*s.* each | 1,200 in no. | 180 | 0 | 0 |
| | | Totall ... | £4,045 | 0 | 0 |

"Besides saucepans, sheets, copper-pots, and warehouse-hire and carriage, whose quantities and values cannot certainly be determined, but are included in the twopences per

man and month (being for 40,000 men, 12 months, £4,000), except the carriage and warehouse.—Ed. Hen. Johnston."

This document is of interest, being dated shortly after Dr. Cockburn had pointed out that the want of such necessaries for convalescents was productive of much loss of strength in the crews; the cost I imagine to have been a free gift, equal to the deduction for wages paid to the surgeon to provide medicines. The prices were much higher then, when money was of greater value, than now. It proves also that there was not then (1702) any naval medical depôt, although there appears to have been one for the Army in the old Savoy Palace, in which the Royal Guards were quartered.

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# ON THE DELHI AND ORIENTAL SORE.

By Surgeon-General JOHN MURRAY, M.D.

(*Read: March 7th*, 1883.)

The subject of the following paper has not attracted much attention in Europe, but the disease is a prominent feature in all tropical climates, and it exists on the southern and eastern coasts of the Mediterranean, and apparently in former times it prevailed in England. It is known by different names in different countries. In Northern India it is called the Delhi, or Mooltan sore, and Aurungzebe; in Madras and Bombay, the Malabar sore; in Ceylon it is called the Parangi disease; in China, Doudanduga; and in the West Indies, Yaws. On the coasts of the Mediterranean it bears the name of "Bouton d'Aleppe", or "Clou de Biskra"; and in England it was called "Sibbins", the nosological name being Frambusia.

The disease is very tedious and troublesome, and, when situated on the face, disfiguring; but it is not dangerous, unless complicated with venereal disease, leprosy, or otherwise bad health from fever, or starvation. These complicated cases amongst the natives of India and Ceylon attracted most attention there. It was rarely noticed amongst the European troops before the Mutiny of 1857, but from that date it became alarmingly prevalent among the troops stationed in Delhi, nearly half the regiments, European and Native, being affected. It was not fatal, but it rendered many of the men unfit for duty. It left permanent scars, which on the face were very disfiguring and disagreeable in appearance. In the garrison occupying the Palace at Delhi, nearly half the European troops were affected. In general the cases were of a trifling nature, not unfitting the men for duty or causing admission into hospital; but still the number of admissions from this cause was considerable, and some of the cases affecting the face were very disgusting.

On receiving reports of this nature, the Government of India appointed a Commission to investigate the subject in the year 1865, consisting of myself, as Inspector-General

Upper Provinces, Deputy-Inspector-General J. C. Brown, and Surgeon H. M. Fraser, of the Rifle Brigade. This Commission assembled at Delhi, and inspected all the cases in the European hospitals and lines, and amongst the Native troops and Native prisoners. At the dispensary in the city they had the opportunity of seeing many cases among the inhabitants. The Commission also inspected a Deota, or Holy Shrine, which was the resort of people suffering from the aurungzebe, who wished to make offerings in hope of cure—and thus they had the opportunity of seeing every variety of the disease. They examined the medical officers in charge of the troops then present, and they collected reports from those who had been lately stationed at Delhi or Mooltan. They also consulted the most eminent hakeems and baids of Delhi, and examined the barbers, to whom the care of these slight surgical cases was always transferred by the higher class of physicians.

The opinion formed by this Commission, after the most careful consideration of all the facts that came to their notice, was, that it is simply a cutaneous disease of parasitic origin, and that the *habitat* of the parasite that caused it was the wells of Delhi. As there is considerable difference of opinion in the profession regarding the cause and course of this sore, arising from complications which are not constituent parts of the disease, it may not be uninteresting to give a history of it, in its simple form, and to detail the facts brought before the Commission, as well as some experiments to which they had recourse during their investigations.

The Delhi sore generally appears on an exposed part of the body, and is at first like an irritated mosquito bite; it continues for some weeks as a dull pimple, which slowly increases in size. It has a smooth, shiny surface, and through a small opening at the top a thin fluid escapes and dries, forming a brown scab, which gradually increases in circumference and height. It is not painful, but inconvenient and unsightly. When the scab is removed, an indolent circular ulcer, with undermined edges, is exposed; when several sores coalesce the shape varies. The granulations are large, often like a raspberry, and covered with a slight puriform discharge. The sores often heal irregularly, in patches in the centre, and leave a depressed cicatrix. The disease is very persistent, sometimes lasting for years.

The Commission considered it a specific cutaneous disease of local origin, and unconnected with hereditary predisposition or constitutional derangement, though frequently super-

added to some other disease, to which the person affected may be subject; and in some of these complications assuming a dangerous character and accelerating a fatal result. The most dangerous of these complications is leprosy, which is generally found in tropical climates, and is frequently taken for this disease, or supposed to be a modification of it. In some forms it bears the closest resemblance to secondary syphilitic eruptions. Of course persons with a syphilitic taint are equally exposed to this disease with others in the locality, and the diagnosis in these cases is extremely difficult. In a London hospital such sores would be called lupus, or rupia. In Ceylon the disease was formerly supposed to be of syphilitic origin, and called the Portuguese, or Spanish pox, as it was not described by native writers before the arrival of the Portuguese in Ceylon.

This disease is known to have existed at Delhi from time immemorial, and has got the name of Aurungzebe, one of the most famous of the Mogul emperors. The inhabitants outside the city walls are little affected by it. It scarcely appeared amongst our troops while they occupied cantonments about two miles from the city; and at that time only a few Sepoys suffered who were on sentry duty at the Arsenal and Palace inside the city. Hence the Commission sought for the origin of the disease within the city walls. They found that the water in all the wells was very bad; in some instances resembling sewage-water. It was carefully analysed by Dr. Lackerstein, as well as the water of the Jumna and canal. We found no record of the wells having ever been cleaned out. It certainly had not been done since 1856, and very probably not for centuries before. At our request instructions were given by the Commissioner, Colonel Hamilton, that all the wells should be cleaned. From nearly all many bones were taken out, and from one in the centre of the city I saw a cart-load of human and animal bones collected. A similar disease is known to exist in most of the ancient cities of the North-west Provinces and Punjaub. Attention has since been directed by Government to the state of the wells and the water-supply in all the large towns and cantonments in India; and careful analysis of the water has been made by officers appointed for that duty, with manifest advantage to the residents. This has been especially the case at Delhi, where the Delhi sore has almost disappeared from amongst the European troops, and is very much diminished among the Natives. This strengthens the view taken by the Commission of the connection between the well-water and the disease.

It did not appear to us, however, that this disease was contracted from drinking the water of the wells, but rather from its use for washing or bathing purposes. The position of the sores would indicate their probable origin, being generally on the uncovered parts of the body.* The germs of the parasite enter the skin through an abraded surface while bathing—probably merely the scratched surface of a mosquito-bite, or through a slight wound, an ulcer, or a common boil. Once in the body the germ propagates the disease, and a sore results. The apothecary of the 38th Regiment mentioned that the disease appeared in a slight cut on his own hand, and that several of the hospital attendants had been similarly affected. The sub-assistant surgeon at the Dispensary reported analogous cases, and both were of opinion that the disease was contracted from contact with the sores of patients suffering from them. This opinion is possibly correct; but at the time they were dressing these sores, they were habitually bathing in the well-water, which we supposed to contain the germs of the disease. On one occasion General Wheeler, commanding the division, remained two days at Delhi, inspecting the troops. A few days after his return to Meerut a Delhi sore appeared upon his leg. "You doctors say that this disease arises from using the Delhi water," said he. "Now that is a mistake, for I never drank a drop while I was there." "But I suppose you bathed with the Delhi water?" said I. "Of course," he answered; "I did not think of that." We met with no satisfactory evidence of the disease being induced by drinking the well-water. Still the Commission advised that it should not be used by the troops unless boiled and filtered; and in no case should it be used for washing or bathing purposes; and in all cases river or canal-water was declared preferable.

The valuable report of Dr. Kinsey on the Parangi disease in Ceylon traces its connection with impure water, as he says it will always appear when the village supply is dried up in the hot season. It prevails most extensively in the northern part of the island, in the Vanni district, and is very fatal when prevailing in seasons of scarcity or famine. He, and most of the medical officers in Ceylon, consider it a cachectic disease, and certainly cachexia often renders it fatal, as well as other specific diseases; but the strong and healthy are equally liable to attacks while using the vitiated water. The pictures illustrating the Parangi disease, which

* It may be worth while to mention that this disease is common on the noses of the dogs at Delhi.

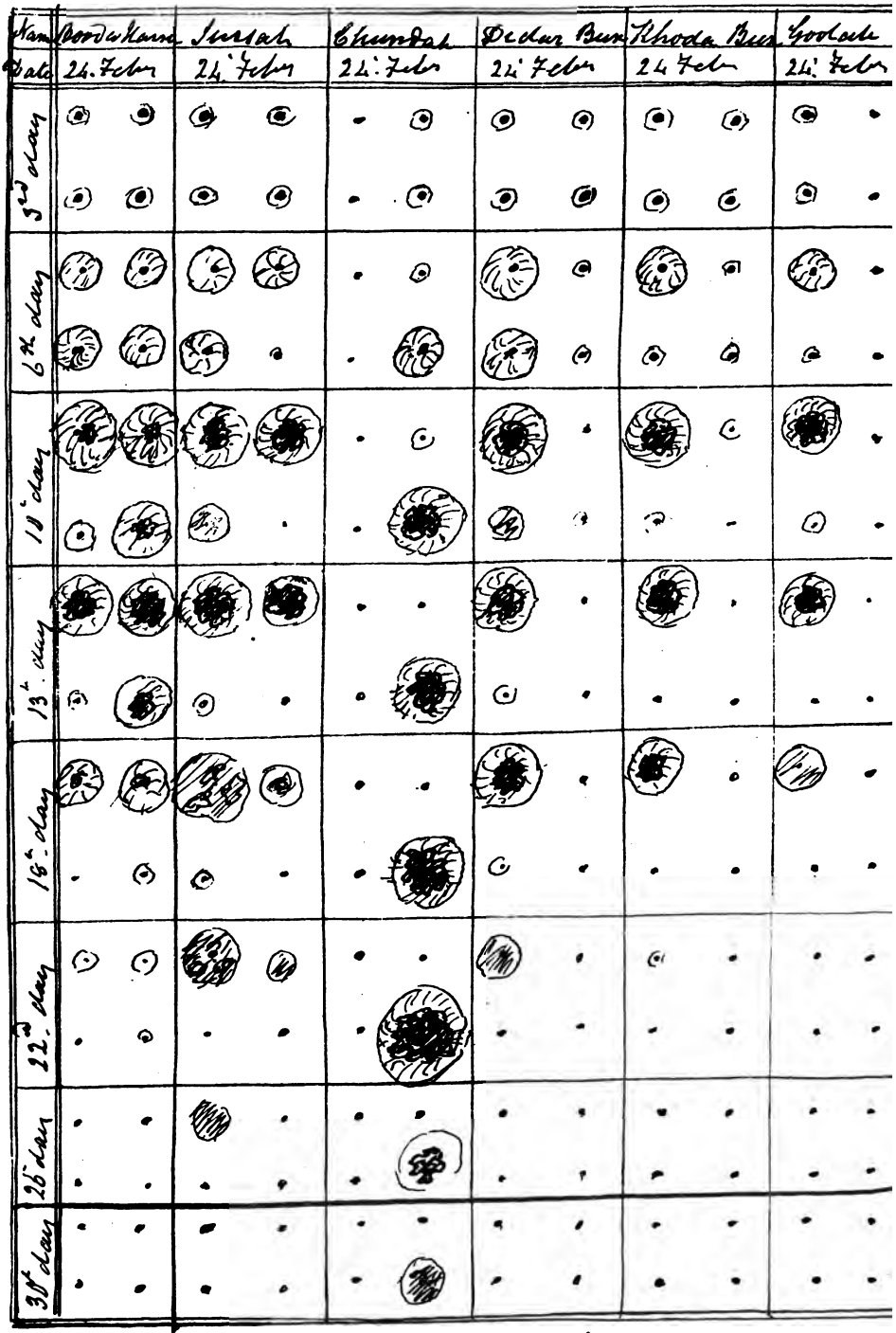
accompanied Dr. Kinsey's Report, are now in the Library of the College of Physicians. I have examined them, and consider the disease they portray identical with the Delhi sore. There are also some photographs of the Yaws from the West Indies, as well as copies of those now shown. They appear identical.

Subsequently I received numerous communications from medical officers who saw the disease at Delhi and in the Punjaub, which strongly supported the views of the Commission as to the local and non-constitutional nature of the disease.

There is great difference of opinion among the writers on this disease as to its contagious or non-contagious nature. One of the members of the Commission, Surgeon H. M. Fraser, whose regiment had been stationed at Delhi for a year, was decidedly of opinion that the Delhi sore is not contagious, from the fact that officers suffering from the complaint did not communicate it to their wives, and *vice versâ*. Also because he had not heard of a single instance of the disease being communicated to anyone outside Delhi by patients suffering from it. Cases of whole families being affected were numerous at Delhi, and are common in all places where the disease, under its various names, has appeared. The French medical officer in the Mediterranean reports instances of this disease spreading in a locality or in a school after the arrival of a person suffering from it. With such varying testimony the simplest and most satisfactory manner of determining this point appeared to the Commission to be by observing the effect of inoculation from the sore or scab.

At the Dispensary, therefore, six men, who, for a reward of 4 Rs., were willing to submit to the operation, were inoculated from a dry scab in the manner in which vaccination is performed from a dry crust. All these cases failed to produce any result. Six cases were then operated on from a fresh sore on the forehead of a boy. Two punctures were made in each arm; and of these twenty-four punctures, on the second or third day twenty-two showed signs of irritation similar to vaccination. The spots then gradually increased, when, being satisfied that the eruption was identical with the disease from which the inoculated matter was taken, remedies were applied, to all but two, to check its progress. A few days after, when the sore had extended to about an inch in diameter, in the case that was left unchecked, that also was treated, and all were cured without any subsequent

Inoculation from fresh Delhi Lore on the 24th Febr 18[illegible]
at the Delhi Dispensary - Half size




John Murray

sequelæ. These experiments would have been more valuable had they been performed also on persons who had previously suffered from the disease, or on whom sores were present in other parts of the body. This would have assisted in determining the protection afforded by one attack against subsequent ones, and shown if the action of the poison was merely local and temporary. It is very desirable that such experiments should be carried out by the medical officers who are located at Delhi. The facility with which the progress of the sore can be arrested, without any subsequent danger, was clearly shown in the cases that have been described.

I think it is proved by this history of the Delhi sore that it arises from the presence of a foreign body, germ, or parasite, which has entered through an opening in the cuticle and developed in the cutis vera, exciting inflammation, which extends to the surrounding parts. The *habitat* of this parasite appears to be impure water in hot countries; and under certain circumstances it is transmissible by inoculation or by contact with an open sore. The Commission attempted to detect the presence of a parasite or germ by means of the microscope at Delhi, but did not succeed. In Calcutta they were equally unsuccessful where crusts were forwarded for examination. Since that time, Dr. Flemming and several other observers have reported that they have detected the germ; but as Drs. Lewis and Cunningham, after a most careful examination in Delhi, have not observed it, though they have minutely delineated the change of structure in the surrounding parts in their report of 1875, implicit reliance cannot be placed on the observations of less experienced microscopists. From observation of their work while searching for the cholera germ in Calcutta in 1870, I was inclined to think that the germ of cholera, small-pox, and most specific diseases, existed in the milky cloud that surrounds the material bodies in all microscopic cultivations. This cloud to the naked eye is resolved by microscopic power to a swarm of lively vitalities, leaving a cloudiness behind, which a higher microscopic power again resolves into myriads of active moving bodies—in the same way as the telescope resolves the milky way in the sky to a multitude of stars. It is highly interesting to identify and individualise the specific germ, and to classify it as belonging to the animal or vegetable kingdom, or to some earlier stage of vital development, which may not be appreciated by the optic nerve even when assisted by the most powerful microscopes;

but it is a more important practical question, how to kill it, or prevent its development in the human body. To attain this object, the treatment may be divided into two parts, viz., the prophylactic and the medical. Both are clearly indicated by the nature of the disease, if it is, as we have suggested, caused by a parasite from foul water entering the body through a breach in the cuticle. The prophylactic treatment would therefore consist in not using such water for bathing or washing purposes; and, should it be absolutely necessary to use it for drinking, to have it first boiled and filtered. Contact with open sores should be avoided, as in dressing them risk is incurred, if there should be any wound or abrasion upon the hand.

The curative treatment must be to destroy the vitality of the parasite. In the papillary, or mosquito-bite stage, the simplest and most efficacious remedy is the actual cautery, by a small ball of iron, or a button made red-hot in a spirit-lamp or charcoal-fire, and applied to the part. In 1865, I treated about fifty such cases in this manner one morning among the men of the 38th Regiment, and only in one or two cases failed in immediately checking the disease. In such instances, or when the ulcer is already extending to a considerable size, the potential cauteries, as potassa, fusa, nitrate of silver, nitric acid, etc., may be used; and various remedies, as arsenic, sulphur, zinc, mercury, carbolic acid, etc., either alone or in combination, judiciously applied. Such treatment was used to the inoculated sores which we had allowed to progress for two or three days, after which a simple dressing was applied with carbolic acid, and they rapidly healed.

In Dr. Milroy's valuable report on Leprosy and Yaws in the West Indies in 1873, the description of the sores corresponds very closely with that of the Delhi sores, and the accounts furnished by the different local medical officers fully confirm this view. The report of Dr. Bowerbank is the result of long and careful observation. The progress of the non-complicate sores is analogous, but he attributes the attacks to personal contact with diseased persons. The disease is generally supposed to be of a cachectic nature.

The Hospital Returns of the Troops and Prisoners afford no clear statistical data regarding this disease, as there is no especial heading for Delhi sores. They are included in the group "Ulcers" and "Abscesses". The reports of the Sanitary Commissioner with the Government of India show the admissions under that heading (there are no deaths) from 1858, the year that troops were first quartered inside the

walls of Delhi, up to 1880, a period of twenty-two years, amongst the European and Native troops in the Meerut Division and in the Punjaub. This table is very imperfect, and can only be used as giving a probable indication of the diminution of the Delhi sores since 1865, by dividing it into two periods, *i.e.*, before and since 1865, and comparing the two. But even this is an imperfect standard, as the troops at Delhi were only about twelve per cent. of the Meerut division.

In the Punjaub, the cases have been altogether less numerous, and any improvement less decided. In the Punjaub, no troops are stationed inside city walls, as at Delhi.

Return No. 5 shows the number of cases of Aurungzebe sores in four of Her Majesty's European regiments stationed at Delhi from 1st April 1861 to 31st October 1865. The annual rate of admission in the regiment previous to 1865 varied from 40.73 per cent. to 75.44 per cent. In 1865 it diminished to 22.75 per cent., and since then it has continued low. Occasionally it has been reported as absent, but I am unable to furnish the details.

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*Return showing the Admissions into Hospital from Ulcers and Abscesses amongst the European and Native Troops, from* 1858 *to* 1880, *in the Meerut Division, including Delhi and the Punjaub.*

MEERUT DIVISION, ROHILCUND, DELHI.

| European Troops. | | | | Native Troops. | | | |
|---|---|---|---|---|---|---|---|
| Date. | Strength. | Admissions. | Ratio p. c. to Strength. | Date. | Strength. | Admissions. | Ratio p. c. to Strength. |
| 1858 to 1865 ... | 75,680 | 11,628 | 15.35 | 1861 to 1865 ... | 47,712 | 7,783 | 16.31 |
| Average of 8 years. | 9,460 | 1,453 | 15.35 | Average of 5 years | 9,542 | 1,556 | 16.31 |
| Average Delhi... | 1,182 | 1,4[illegible]3 | 118.53 | Average Delhi... | 1,118 | 1,140 | 102.86 |
| 1866 to 1880 ... | 61,150 | 5,638 | 9.00 | 1866 to 1880 ... | 71,817 | 6,243 | 8.84 |
| Average of 15 years. | 4,110 | 375 | 9.00 | Average of 15 years | 4,787 | 416 | 8.84 |
| Delhi 15 years. | 512 | 50 | 10.00 | Average Delhi 15 years | 559 | 52 | 8.84 |

TABLE—*continued.*

PUNJAUB.

| European Troops. | | | | Native Troops. | | | |
|---|---|---|---|---|---|---|---|
| Date. | Strength. | Admissions. | Ratio p. c. to Strength. | Date. | Strength. | Admissions. | Ratio p. c. to Strength. |
| 1858 to 1865 ... | 128,000 | 13,696 | 10.70 | 1861 to 1865 ... | 50,548 | 7,355 | 14.55 |
| Average of 8 years | 16,000 | 1,712 | 10.70 | Average of 8 years | 10,100 | 1,471 | 14.55 |
| 1866 to 1880 ... | 179,550 | 15,995 | .30 | 1866 to 1880 ... | 218,623 | 19,457 | 8.90 |
| Average of 8 years | 11,953 | 1,066 | 8.30 | Average of 15 years | 13,578 | 1,297 | 8.90 |

*Return showing the number of Admissions from Aurungzebe Sores in the European Regiments stationed at Delhi, from 1st April 1861, to 1st November 1865.*

| Corps. | Date of. | | Strength. | Admissions from Aurungzebe. | Ratio p. c. per ann. of Cases to Strength. | Remarks. |
|---|---|---|---|---|---|---|
| | Arrival. | Departure. | | | | |
| H.M.'s 82nd Regt. | 1861 1st April | 1863 22nd Feb. | 739 | 612 | 40.73 | ... |
| 2nd Batt. Rifle Brigade. | 1863 February. | 1864 March. | 713 | 582 | 75.44 | ... |
| H.M.'s 38th Regt. | 1864 1st April. | 1864 4th Dec. | 606 | 241 | 55.44 | ... |
| H.M.'s 98th Regt | 1865 24th Feb. | 1865 31st Oct. | 322 | 40 | 22.56 | There were 99 sores. |
| ... | ... | ... | 2.380 | 1,475 | ... | ... |

# MEMORANDUM CONCERNING CHOLERA.

By GEORGE BUCHANAN, M.D., F.R.S.,
President of the Society.

(*Read: July 4th*, 1883.)

1. *Narrative.*—Cholera reached Europe by way of Egypt for the first time in 1865. Before that date, its course from Asia had been through the Russian Empire.

At the first appearance of cholera in Europe, over forty years ago, it began in Great Britain fifteen months after its introduction to Europe. At its second appearance, it began with us in England after about the same interval. Its third appearance does not admit of comparison with the others.

At the fourth appearance of cholera in Europe, when it came by way of Egypt, it was epidemic in the Hedjaz in May; it appeared at Alexandria on June 2; was at Malta, Smyrna, and Constantinople before the end of that month; and appeared in Spain and Italy and at Marseilles during July. Spreading somewhat widely in Europe during the next two months, it was at Southampton on September 17 and on November 3 it was witnessed at New York. In the spring of 1866 cholera acquired an increased diffusiveness, and by June had attacked many places in the United Kingdom, but hardly any cases occurred in London until July.

[The Suez Canal was opened in November 1869.]

Extension of cholera from Northern Arabia was next threatened in 1871; and the disease prevailed to a small extent in Europe during 1872 and 1873. Since that date, it has occurred several times among the pilgrims to the Holy places, but has not established itself in Egypt, nor has it prevailed in Europe.

Cholera is now at Damietta, a place with some 30,000 inhabitants, about six miles from the mouth of one of the branches of the Nile. The way of its arrival thither cannot be stated. Damietta is not on any highroad from Asia; and the towns above Damietta on the Nile are not known to have been affected before this town. No cholera is known of at Suez, nor in the course of the Canal, though from Port Said an occasional death is now being reported. In the ten days ending last Saturday, about 500 deaths from cholera occurred at Damietta; on July 1, there were 140, on the 2nd

130, and on the 3rd there were 110 deaths. The disease now exists at Mansourah, higher up the same branch of the Nile, and cases are appearing in other towns situated on the railways of the Delta.

2. *Expectations.*—When— I have been asked—may cholera be expected to travel through Europe to England? how long after its present manifestations in Egypt?

Evidently no medical data exist for an answer to the question. We do not understand all the conditions for the diffusion of the disease.

But we in England do firmly believe, what many of our Indian friends would deny, that cholera is influenced in its spread by human intercourse. We do not affirm that it passes from person to person, as small-pox or typhus does; but we believe that it extends, much after the fashion with which we are familiar in the case of enteric fever, by means of the discharges from the sick, particularly if those discharges are received into foul cesspools and drains, or if they obtain admission into drinking-water; and human intercourse is one of the conditions for the spread of cholera in such fashion as this.

If we now, for the sake of hypothesis, suppose other conditions for diffusion of cholera to be to-day what they were in 1865, we may inquire how far the conditions of human intercourse have altered in such wise as to affect the probable dissemination and rate of transmission of cholera in and about Europe. In reply, let it be remembered that, though Egypt has doubtless incurred repeated risk from her communications with the Hedjaz, there is no evidence that even Egypt has been subjected to danger from cholera, at any time, through her direct maritime communications with more Eastern countries; let it be remembered that the Suez Canal has now been open for more than thirteen years; and let it further be noted that the present outbreak of cholera in Egypt is not on the line of traffic between Asia and Europe; and it will appear improbable, I think, that the use of the new highway will affect the course of cholera towards France and England. Still, it is not to be supposed that 1883 will find us in every respect under the same conditions of human intercourse as 1865; and it is possible that some of the changed conditions may be such as to affect the opportunities for the migration of cholera. But, plainly, they are not worth speculating about, in view of our complete uncertainty whether those conditions for the diffusion of cholera which are independent of human intercourse are or are not to be the same in 1883 as in 1865.

3. *Precautions.*—"Quarantine", meaning by the word a system which professes to prevent the entry into a country of persons coming from another country until assurance is attained that no infection can be introduced by those persons, is not now regarded as capable of fulfilling its pretentions; and its least failure to exclude infection is seen to make the whole system irrational, its cost and its vexations unjustifiable. Accordingly, England, which long ago abandoned the system as of no avail against cholera, has now the consent of most European nations (as expressed by their delegates to the Vienna Conference of 1874) in preferring for the defence of her ports another system which, under the name of "Medical Inspection", aims at obtaining the seclusion of actually infected persons, and the disinfection of ships and of articles that may have received infection from the sick.

The details of this system, as formulated for practical application in the ports and waters of England, are set forth in an Order of the Local Government Board of July 17, 1873. Provision is there made for the detention of ships at appointed places; for the visiting and medical examination of ships and passengers; for the removal to hospital of persons suffering from cholera or suspected cholera, and for their detention there; for the speedy burial of the dead; for the disinfection or destruction of clothing and bedding; and for the purification of the ship and articles therein.

This Order is at present operative. From a statement by Earl Granville, I learn that it is proposed to re-issue the Order, though without change in essentials. It represents the system upon which we rely in preference to quarantine for the protection of our shores. For the last ten years the country has been thus prepared for the invasion of cholera, and the fact of this preparedness should be known.

We have reason to hope that, if cholera should enter England, it will find fewer opportunities for doing mischief than at previous invasions. We are generally better provided with defences against a disease which spreads as cholera can spread. Some further precautions for use at the moment will doubtless be requisite; but it will be on our permanent sanitary works and procedure that we shall with most confidence rely.

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# THE SANITARY LESSONS OF INDIAN EPIDEMICS.

By Surgeon-General J. M. CUNINGHAM, M.D.,
Sanitary Commissioner with the Government of India.

(*Read: July 4th*, 1883.)

It was in the early part of 1874, if I remember aright, that a paper on Cholera in India was read by your late President (Dr. John Murray), and that in the course of the discussion which followed I had the opportunity of stating some of the views which I entertained in regard to cholera and other Indian diseases. I ventured to say that I considered the opinions ordinarily held about cholera were opposed to Indian experience; that there was no evidence that cholera is a special product, raised only in the delta of the Ganges, and thence disseminated over the world; and, moreover, that there was no evidence to prove that it is caused by any special contagium developed in the bodies of the sick, and communicated either directly or indirectly by human intercourse. After a lapse of ten years it seems not out of place that I should recur to this subject, and endeavour very shortly to set forth how far the views I then expressed have been affected by further experience. How far have they been modified, and how far have they been confirmed? How far, again, are the general principles which seem to hold good in regard to cholera applicable to other diseases, and especially to some of the other epidemic diseases of India? I esteem myself fortunate in being permitted to bring these matters under your special notice by the reading of this paper, which I have designated "The Sanitary Lessons of Indian Epidemics", and which I shall endeavour to make as brief and practical as possible.

It can hardly be questioned that India presents a grand field for the study of sanitary questions. Its vast extent; the difference in its soil and geological formation; the well-marked and varied features in its physical geography; the variety of climate which it presents, as regards temperature, rainfall, humidity, barometric pressure, and other points; the differences of race, as respects not only nationality, but

also food, clothing, and other habits; the differences of local conditions, and among them the differences in the means of communication over so vast an area, which in some parts are as good as they are in England, and in other parts are no better than they were one hundred years ago; —all these render India a country well worth attentive observation from a sanitary point of view.

India has taught us many lessons in other departments both of peace and of war, and I believe that it is well fitted to teach us most valuable lessons in sanitary matters also. All this will be readily granted. This statement will in all probability be accepted in the abstract; but it may be thought that, grand as is the field of observation, the means of observing are very small. It may be said that the facts are very difficult to ascertain, that error is very apt to creep into all regarding them, and that the whole record is one on which no great reliance can be placed. For this reason it would appear that the data which have been collected year by year in India have hitherto not received the attention which they deserve. It may be granted that the means of observation in India are not so good as they are in some other countries, but, at the same time, they are on no account to be despised. The minute particulars which are obtained regarding our European army, numbering 60,000 men, our native army, numbering 120,000 men, and our prison population, which is never less than 100,000, are all of extreme value, and may fairly take their places for exactness and for minute detail with any sanitary statistics which can be procured elsewhere; and although the statistics of the births and deaths among the general population are still in a very imperfect condition, they yet afford very valuable information—information which is yearly becoming more exact and more valuable in its bearing on the general history of disease in India. But even in its imperfect condition it is remarkable how completely the great facts embodied in these statistics concerning the general population accord with the details furnished by the bodies of troops and prisoners, the exactness of which cannot be disputed.

It may be thought—and I have both read and heard this opinion expressed again and again—that the truth regarding disease is to be learnt rather by an exhaustive inquiry into particular outbreaks than by a consideration of the facts extending over a large area. But it seems to me, as the result of large experience, that in epidemiology undue importance has been attached to local inquiries. Inquiry

into particular outbreaks is, no doubt, very excellent in its way, and more especially into the local insanitary conditions which favour epidemics, the examination of which can never be too searching; but from an epidemiological point of view such inquiry cannot be accepted by itself, independently of the general history of disease. No man of sense or science set down in a village to form an opinion on the causes of the peculiarities in the season—of the excessive rainfall it may be, or of the unusual dryness, or of the potato blight, or any other abnormal condition of the crops—would ignore everything except what came under his observation in that particular village. And yet this is very much what men do who make a purely local inquiry into epidemic disease, and take no thought of what has been going on, or, it may be, is going on at the very time in other parts of the country.

The facts regarding the general history of disease must be considered as well as the results of local inquiry, and in this way these great facts will often prevent wrong conclusions being drawn from the little facts. It is, in truth, essential, if we are to arrive at any sound conclusions, that we should look at all the facts so far as they can possibly be collected. But there is nothing more difficult than to get at the facts. In the course of a long experience there is nothing which has struck me more forcibly than this. The reporters are so apt to confuse between fact and mere opinion, that in the minds of some it seems impossible to separate the two. Again, there is nothing more common than forming an opinion without any (or with insufficient) facts. Then again, there are other fallacies which are extremely common. There is the common fallacy of recording the facts all on the one side, and omitting all the facts on the other side. I have known a man write a report on a local outbreak of disease, which seemed to be very plausible and even convincing, who left out of consideration the whole history of disease among the general population in the neighbourhood, the slightest acquaintance with which would have shown him that his ideas were altogether wrong and would not stand a moment's investigation. I have known another man write a goodly volume to prove his own particular theory, and leave out of it all mention of one little fact which might have been stated in a single line; and yet that little fact was sufficient to show that his whole book was little better than a dream. I do not mention these instances to hint in the smallest possible way that such men are dishonest; but when men become possessed of a theory, they seem incapable of looking at anything except the facts which fit in with that

particular theory. Another common fallacy is to neglect, or attach no importance to, solitary cases of epidemic disease. The diseases which sweep over India, and more particularly "cholera", are diseases which are common enough without any epidemic being present. Solitary instances of cholera occur ever and again far beyond the endemic area, but they are too often passed by as if they were of no consequence. One is attributed to some error of diet, another to exposure, a third to some other cause, and no doubt these causes are not without their influence; but when solitary cases of this kind occur here and there over a large area—although they may appear to be of little consequence to the individual observers concerned with each case—they have to the epidemiologist, who views them all, a significance which is not to be ignored. Epidemiologists, who propose to deal with epidemics and to show the causes to which they are due, must at the same time be prepared to deal with these solitary cases; and I venture to think that even in temperate climates, where such cases, even of cholera, are not unknown, much too little has been made of them. To call such cases "cholera nostras" as distinguished from "cholera Indica", is to make the nomenclature of disease depend on a preconceived theory. They are indistinguishable at the bedside, and the only difference is that while the one occurs in solitary instances, the other occurs in outbreaks of epidemic violence; but there is no reason to suppose that the cause or causes which produce one case of so-called "cholera nostras" may not produce a hundred or a thousand. No one attempts to make any such theoretical distinction between cases of small-pox—to call isolated cases "small-pox nostras," and the cases of an epidemic by some other name. But, in dealing with epidemiological questions, there is yet another evil, which is perhaps even greater than any of those I have already mentioned. It is the evil which arises from taking mere coincidences as evidences of cause and effect. A person suffering from disease, or coming from a place in which disease is prevalent, is attacked, and soon after, one or other of those of his own house or of those living in the neighbourhood is attacked also. The conclusion is immediately arrived at, that the first person has been the cause of the others being attacked; but this is exactly one of those cases to which I have already referred, in which all the instances of one kind are cited, and all the instances of the opposite kind are ignored. It is quite true there are numerous instances on record, in which persons travelling from an affected locality have been seized with disease on arrival in their own

homes, and their neighbours have suffered soon afterwards; but there are innumerable instances in which such travellers have been attacked, and yet others have not suffered. These are all left out of account. It is argued that in the one case the evidence is positive, and that in the other it is negative; but this is altogether a fallacious view of the question. There is no positive evidence either on the one side or on the other. The only facts we have are facts relating to time—the traveller suffers first, his neighbours suffer afterwards; therefore the neighbours have been affected by the traveller. This subject is one of very great importance, because a clear understanding of it lies at the bottom of all medical evidence. If it had been proved that a person suffering from cholera, or other epidemic disease, really propagates a specific poison, then the cases in which the neighbours were affected might be regarded as positive evidence; but, in the absence of such proof, no conclusion can be arrived at unless the facts on both sides are carefully collated. If the facts on one side only are considered to be evidence, it would be possible to prove almost anything. I remember when I was a boy it was a common remark that the frost came down with the mail-coach; and, no doubt, there were numerous instances in which the arrival of the mail-coach and the setting in of the frost were contemporaneous. Had I been anxious to prove that the mail-coach really did bring the frost, all that would have been necessary, according to the ordinary mode of medical evidence, would have been to cite the number of instances in which the two things were contemporaneous, and leave out all the other instances in which they were not contemporaneous. It may be said that nobody would do anything so foolish as this; but this is exactly what is done in regard to cholera, and the supposed spread of cholera by means of pilgrims.

All the instances in which pilgrims are first attacked and the general population suffer afterwards are cited; but nothing is said of the many instances in which either the general population is attacked first, or in which the pilgrims are attacked, and no cases follow in the localities through which they pass. Yet without these cases the evidence is altogether incomplete and one-sided, and therefore no sound conclusion can be based on it. The reasoning now is all carried on in a vicious circle. The supposed spread of cholera by human beings is asserted on the strength of facts selected all on the one side, and which are dignified by the name of positive evidence on the ground that these human beings have conveyed the "germ" or "contagium", the results

of which are manifest in the persons of those among whom the travellers have come. But if evidence be asked of the existence of this supposed germ or contagium, the cases of these same pilgrims and other travellers are cited! And so, as I have already said, the argument proceeds in the same vicious circle. If the existence of the germ or contagium had been demonstrated, the case would be very different. Until it has been demonstrated, the evidence on the one side is just as important and just as positive in its character as the evidence on the other side.

But, having got all the facts, so far as they can be collected, it is essential that the deductions drawn from them should be strictly logical. If the question were asked of a hundred people, "What is the cause of epidemic disease?" ninety-nine of them would probably reply that epidemics were due to contagion, that a sick person coming from some place or other brought with him the germs of the disease, and that those germs found a fitting place for development in the persons of other people. But such an explanation, however plausible it may appear at first sight, is really no explanation at all; for, if we follow back and trace the individual who is supposed to have brought the disease, and ask where he got it, and then trace the third person back and ask where he got it, and so on, we have still the same question to answer, "How did this disease arise?" The doctrine of importation merely puts the question off. If a community whom we may call Z. is suffering from an epidemic, there is little satisfaction in being told that this epidemic was imported from Y., and that the epidemic in Y. was imported from X., for if we trace back and back we must eventually come to A., and the question then arises, exactly as it arose with regard to Z., "What was the cause of this disease?"

In dealing with epidemics, and, in fact, with the causation of all diseases, we must assume nothing. In the present day the germ theory is in great favour. Germs are supposed to account not only for cholera, small-pox, and enteric fever, but also for tubercle and ordinary malarial fever. There seems to be no limit to the germ theory of disease; but, as a matter of fact, do these germs really exist? Have they been found in diseases such as small-pox or syphilis, which are usually cited as the most striking examples of contagious disease? Is there a single so-called germ which can be shown under the microscope and recognised as the germ of any particular disease? Is there a single organism derived from a person suffering from a particular

disease which can be said to be the cause, and not a consequence, of that disease? Is there a single organism found in disease which alone is capable of producing that disease? Every now and again the medical world is startled by the announcement that one of these specific germs has been discovered, and the announcement is far too readily credited, for, as time goes on, grave doubts are thrown on the accuracy of the supposed discovery. A year or two ago we were told that malarial fever was no longer a difficult problem to solve —a bacillus had been found to account for everything—but now we have two organisms in the field, which both claim the supposed honour: one the bacillus of Tommasi and Klebs, and the other of Laverac, which I believe is not a bacillus at all. Again, we had the bacillus of tubercle announced by Professor Koch, but, according to the latest intelligence, Spina and other of Stricker's pupils have found in typhoid fever stools, in the sputum of pneumonia, asthma, and bronchitis, and in the lochial secretions, a bacillus which in form, size, arrangement, and reaction is indistinguishable from the tubercular bacillus of Koch. I have no intention of entering on the germ question in general, but the questions I have suggested are very pertinent in the history of Indian diseases, and more especially in the history of cholera and enteric fever, in regard to which I would venture to offer a few special remarks. What do we know, or what do we not know, about these diseases? Cholera is said to be due to a germ or poison spread by the skin—a poison which is bred in the delta of the Ganges, and thence carried over the world. These were propositions which were formulated by the Sanitary Conferences of Constantinople and Vienna, and are generally accepted as embodying the truth; but I venture to think that they both rest on a most imperfect foundation. They are based chiefly on a series of one-sided anecdotes, which are not only one-sided, but which are, moreover, opposed to all that is known of the great facts regarding cholera. Human intercourse is free and uninterrupted all over India, and yet for years together great parts of this large continent remain unattacked by cholera. Even in those instances where great fairs have been succeeded by a prevalence of cholera, this prevalence has never been general in all directions. The pilgrims going in particular directions no doubt have suffered, but the pilgrims going in other directions have, after the first day or two, when they seemed to be suffering from the influence of the place from which they had come, entirely escaped. The real explanation of the pilgrims' sufferings is to be found in the fact

that they have traversed a "cholera area" at a time when, ill-fed and filthy, exposed to hardship and fatigue, they have been in a condition most favourable to be attacked.

The history of attendants on cholera cases is in itself a sufficient answer to all that has been said in regard to pilgrims spreading cholera, for the evidence is complete that the attendants on cholera cases suffer no more than other people. I have now the details of nearly 8,000 attendants on cholera cases, and of these only 150 were attacked. Such a result cannot be accepted as evidence of contagion, especially when it is remembered that they were subject to the same conditions as the ordinary inhabitants of the place. On the contrary, it shows an absence of contagion under circumstances most favourable to contagion if any had really existed. If attendance on the sick for many days and nights is not a service of danger—and the whole experience of India shows that it is not—what is to be said of the innumerable instances of supposed contagion where the persons attacked were only residents of the same place, and never came into communication with the sick at all?

There is another great fact regarding cholera which is too often ignored—that even over an epidemic area the proportion of villages attacked is comparatively small. If cholera be due to human intercourse, how is it that even in times of severe epidemics the proportion of villages that escape is much larger than the proportion that suffers? The general direction of a cholera epidemic, moreover, is opposed to the idea that it is governed by human intercourse, or any other chance; and if the believers in the water-theory, as it is called, will examine the facts regarding the great rivers of India, they will find that the advance of cholera is in directly the opposite direction to that in which, according to their theory, it ought to be. They will find, moreover, that the children, who drink more water than any other portion of the community, are especially exempt. The real truth, so far as we have yet ascertained it, in regard to cholera is its remarkable localisation; and the real remedy is to be found, not in any endeavour to prevent human intercourse—which is impossible—or to destroy the germ, the very existence of which remains to be proved, but to carry out sanitary improvements, and if, in spite of them, cholera should still prevail, to move away from the affected locality. The advantage of movement has been exemplified over and over again, and never more strikingly than in the outbreak at Meanmeer in 1881, when the troops, on three occasions, shook off the disease by moving into camp about

a hundred miles away, and were attacked again immediately they returned.

Experience in regard to enteric fever teaches very much the same lesson as experience in regard to cholera. When this disease was first returned in India under its new name, medical officers commonly attributed it to importation. Some one had brought the disease; where it originally came from, no one could say. The explanation, such as it was, was very simple, and, at the same time, very unsatisfactory. And more accurate and extended observation has shown that it is not only unsatisfactory, but also altogether inconsistent with facts. We now know that enteric fever is a disease peculiarly common among young European soldiers recently arrived in India. We know that it occurs over a large extent of country in isolated cases; that it does not spread from the sick to the healthy; that the attendants are no more exposed to danger than other people; and that the common source to which it has been attributed so often in England, namely, the milk-supply, cannot hold good in India, for this simple reason—that the children, who consume most milk, are, with rare exceptions, exempt. What is the real nature of this fever it is not for me to say; but, considering that it presents itself under a variety of phases, that in its early stages it is almost always indistinguishable from the intermittent or remittent, it does not appear unreasonable to class it as one form of malarial fever due to climate aided by local conditions or the other causes to which malarial fever is due. There is certainly no evidence that it is due to any specific germ. Undue importance seems to have been attached to a name. There can be no question that the fever which is now returned so commonly in India as enteric fever is simply the same fever which used to be returned in former years as remittent fever; and whatever advance may have been made in pathology by the change of name, the tendency in the treatment has been decidedly hurtful—for there has been a hesitation in the administration of quinine, or a withholding of it altogether, when its use might have been attended with decided benefit.

Mere fashion has, I regret to say, a good deal to do with even the statistics of disease. Although the mortality from fevers as a whole has certainly declined in India compared with what it used to be, the proportion of that mortality ascribed to enteric fever has been gradually increasing, while the proportion ascribed to remittents and other more generally recognised forms of malarial fever have been gradually decreasing. The general results of 1881—the last

year for which I have the records with me—merely repeat the experience of former years. The percentage of liability to enteric among men under twenty-five years of age was 60; between twenty-five and twenty-nine years only 20; and between thirty and thirty-four years of age only 10. In respect of Indian residence the figures are even more striking, for during the first and second years of residence the percentage of liability to enteric was 60, while from the third to the sixth year it was only 27, and between the seventh and tenth years it fell to 7. It is difficult, and indeed I believe it is impossible, to reconcile these great facts with any theory which ascribes the disease to a specific germ, or specific contagium communicated from the sick to the healthy. It has been argued that the disease described as such in India is not really enteric, because in Europe enteric arises under conditions which do not exist in India. But, if clinical observation and post-mortem appearances are to go for anything, there can be no question that the enteric of India, as seen among European soldiers, is one and the same as the enteric seen in England, though in India the degrees of severity are very various, and it is often impossible to say whether the fever should be called enteric or remittent, or even intermittent. May not the true explanation of the facts be this—that disease, instead of being caused by one specific germ, is really the product of many causes, some of which operate most strongly under certain conditions, and others operate most strongly under other conditions?

When the evidence is carefully sifted, I venture to think that there is very little to support the theory that either cholera or enteric fever is due to a specific poison. It is important to make this point very clear, because until it is made clear the practical action to be taken is apt to be misunderstood.

You will ask, then, What can be the cause or causes of this and other diseases? I can only answer, that in the present state of our knowledge we cannot speak with any exactness. The explanation will, no doubt, be found in climatic and other conditions affecting certain localities, and materially aided by the insanitary condition of those localities. I have heard it argued that it is impossible to deny the existence of an entity as the cause of disease; the mere presence of the disease is in itself sufficient proof that this entity exists. But such reasoning is altogether fallacious. Disease may be due, as many other things are due, to a force or forces. The greatest powers we know of in the world are not entities at all—such, for example, as wind, steam, and electricity.

No one doubts their power, and yet we know that in neither one nor the other are the tremendous results to be ascribed to the existence of any entity, to anything which can be seen by the naked eye, or demonstrated under the most powerful microscope. You may think that these are merely theoretical views which have little or no practical application; but I believe that they are really of very great practical importance, and that they in fact lie at the root of all sanitary progress. The doctrines which have been so commonly preached of late years regarding germs and the danger arising from the sick, have been attended with most disastrous consequences, and there seems every reason to fear that these disastrous consequences may increase rather than diminish. Much domestic misery is caused by the removal of a sick person from the midst of his family. I have known wives separated from their husbands, and children from their parents, to die in a hospital unattended by those whose duty under any circumstances was to have nursed them in their extremity. I have known the greatest fear and alarm pervade a community on the first mention of disease supposed to be contagious—a fear which was so general and so great, that it was a matter of difficulty to obtain attendants for the sick; and when attendants were found they entered on their duties in a state of alarm which was little calculated to aid in their discharge, but rather fitted them to become easy victims to the prevailing disease. The consequences have been mischievous, not only in regard to domestic arrangements, but in regard also to national arrangements. The quarantines which have been set up at Suez of late years, and which are again and again imposed without the smallest necessity, are the natural outcome of the views which have been so loudly proclaimed. True, English authorities, although they have supported the germ theory very warmly, have at the same time expressed their decided opinion that quarantine is useless. But people cannot be blamed if, believing in germs, they should take every possible precaution to keep them out. They may say, "You yourselves have expressed your opinion that cholera, for example, is due to a specific poison which is carried from the delta of the Ganges by human beings all over the civilised world. You object to quarantine, it is true; you say it is useless, but here your views are distorted by your self-interest. You do not wish your trade to be interfered with, and therefore you tell us that quarantine is of no use. At all events, we will try; if we fail to keep out all the germs which are so destructive to mankind, we may yet be

successful in keeping out some of these germs, and surely, according to your own showing, every germ kept out must be a decided gain."

The quarantine restrictions are imposed at the will of international boards sitting at Constantinople and Alexandria. They are one of the consequences of the Constantinople and Vienna Conferences, and, so far as their action has hitherto been seen, it seems to me to be one of unmixed evil. They proceed on the principle that there is a great danger arising from Indian ships, and that this danger can be averted by the measures which are taken under their orders. But the danger of which they speak is a purely theoretical danger. There is no evidence whatever that Indian ships have ever brought cholera. The Red Sea route, along which this constant source of danger is supposed to exist, has been singularly free from cholera, and that, too, over a period during many years of which cholera was prevalent in Europe.

During the seventeen years from 1865 to 1881, so far as is known, there is no ground for supposing that Indian ships have imported cholera either into Egypt or into Europe. What is perhaps even more striking is the further fact that although Egypt has been in direct and never-ceasing communication with India throughout this time, it has preserved a remarkable immunity from cholera. The general distribution of the disease in Europe and Asia during a series of years is clearly shown on the maps attached to Mr. Radcliffe's "Papers concerning the European Relations of Asiatic Cholera", published in the "Report of the Medical Officer of the Privy Council and Local Government Board", new series, No. v, and which is all the more valuable for any purpose because Mr. Radcliffe is well known as a warm supporter of the doctrine that cholera is spread by human intercourse. From these maps and the Report itself it appears that there was cholera in Egypt in 1865, but it is admitted that this was not imported by ship to India. In 1866 there was a slight reappearance of the disease, but there has apparently been no cholera in Egypt from that time up to the present year. During the ten years 1865 to 1874, to which the report of Mr. Radcliffe refers, there is not a single year in which Europe was absolutely free from cholera, and in some of them after 1866, as in 1867, 1869, 1870, 1871, 1872, and 1873, there was considerable prevalence. In other words, notwithstanding the supposed danger from Indian ships, Egypt for fifteen years has been altogether free from the disease, and yet during many of these years India

has suffered from most serious epidemics of cholera. The experience of Aden is even more striking. It suffered from cholera in 1865, and again to a slight extent in 1867; but although it lies within a few days of Bombay, and although it has been in daily communication with that and other Indian ports, it did not once suffer from cholera during the thirteen years 1868 to 1880. I do not refer to the outbreak at Aden in 1881, because it does not affect the general truth that over a long series of years this place has been singularly free from cholera. It is not necessary to go further back than 1865, and it would be difficult to ascertain the facts for the earlier years with any accuracy; so far as they are known, they confirm the experience of more recent times. It must be borne in mind, moreover, that the whole period above referred to—from 1865 onwards—is a period during which there was practically no quarantine along the Red Sea line. The fear of the importation of cholera from India into Egypt and Europe by means of ships is based, not on facts, but on the theories of the conferences as to what ought in their opinion to have taken place, but what, so far as the evidence goes, never actually has taken place. It is impossible, in the face of these facts, to maintain that Indian ports and Indian ships have proved a source of danger to Egypt, and through Egypt to other countries.

The boards proceed on the assumption that prevalence of cholera in India means increased danger to Europe; but this is an assumption which is altogether negatived by past experience, and it would appear rather that when cholera is in comparative abeyance in India this is the time of danger to other countries.

Again, it is admitted that the land traffic cannot be brought under quarantine restrictions; and so we have this very remarkable state of things, that while traffic of the land along which cholera does appear is practically left to itself, the traffic along the sea route, which is so singularly free from cholera, is subject to a never-ending interference.

If all this be the truth—as I believe it is—it is abundantly clear that these boards have really no basis whatever on which to form an opinion, and that their action—harassing and annoying as it is to trade, and the cause of serious loss to shipowners—can be of no practical benefit to anyone. It would be much better if the time and money expended in quarantine arrangements were devoted to cleansing the towns of Egypt and other countries where the conditions are so favourable for disease. The maritime nations of Southern Europe are no doubt fully impressed with the

belief that quarantine can protect them—especially from cholera. There can be no objection to give in to their prejudices in any reasonable way. The Constantinople and Vienna Conferences both expressed a decided opinion that the period of incubation of cholera did not exceed eight or ten days; and if this statement were acted on in practice, the prejudices of all who believe in quarantine would be respected, while trade would suffer no injury; for the instances in which cholera has appeared on board ships going from Indian ports to the Red Sea are so extremely rare that they need hardly be taken into account.

There is yet another, and, if possible, greater evil still which results from the views regarding the causation of disease so common in the present day, and that is that the importance of sanitary improvement does not receive that attention which it ought to do. If disease be due to a specific germ, then there is no danger to the community so long as that specific germ is not introduced. The place may be in the most unsatisfactory condition, both as to its conservancy, its drainage, or its water-supply; but, if the specific germ does not find entrance, these conditions are of little or no importance. But if, on the other hand, it is believed that disease is in the main the product of insanitary conditions, the community will be much more likely to bestir itself to improve them. They will feel that it is not sufficient to put their water-supply, or their drainage, or their conservancy in a proper state, lest some germ should be introduced; but that it is absolutely necessary, if they are to maintain a good standard of health, that they should have these requisites at all times. There is, no doubt, something which is acceptable to the human mind in the theory which ascribes disease to somebody else; which is satisfied with the explanation that the mysterious "it" was brought by some one else; which is willing to blame others, instead of blaming oneself, for the neglect of sanitary arrangements. The one idea that seems in the present day to pervade the minds of many men in regard to sanitary matters, is that if a person is suffering from a so-called contagious disease he should be immediately isolated, or, in other words, put in a sort of medical prison. The improvement of sanitary conditions is to them a matter of singularly little moment: and yet the only safe and practical sanitary creed is that disease is not to be prevented by any such means; that it is due to causes existing chiefly in the locality where it occurs; and that it will continue to exist until these causes have been removed.

In regard to small-pox, no doubt we have a special means

of precaution in vaccination; but even with regard to small-pox it seems extraordinary how the danger arising from the sick person seems to overshadow everything else. In India more especially, such procedure is attended with very lamentable results. We endeavour to persuade the natives of India that vaccination is an admirable protection against small-pox, and yet the moment a case of small-pox is heard of there is the greatest alarm, just as if vaccination were no protection whatever. The natives are not slow to reason from the facts which come under their observation, and are little likely to place reliance in vaccination when they see that those who applaud it so loudly believe in it so little themselves.

People seem to think that if a germ could be discovered as a cause of every disease a great advance would be made not only in our knowledge, but in our means of preventing disease. Knowledge on all points is much to be desired, and if it should appear hereafter that diseases are really due to germs, the question will then arise, What action can be taken in regard to them? But it seems to me that the discovery of disease germs, which people hail with so much satisfaction, would be very far from a gain to the human race. For, if a germ can only be distinguished and discovered by a high-power microscope, it seems hardly probable that it can ever be dealt with in practice by a sanitary police. Cleanliness in every form, cleanliness of the air, of the water, and of the soil, are the great ends to be aimed at. The great lessons I would draw from the experience of India in such matters are: 1. The importance of ascertaining the facts, both those respecting the localities immediately concerned and the general history of disease at the time, and of recording them *all fully*, instead of recording only those which tell either on the one side or on the other. 2. Having collected all the facts, we must assume nothing, and draw from them no conclusions except such as are strictly logical. 3. That, however the questions may be affected by further research, the doctrines of germs or contagia communicated from the sick to the healthy will not account for Indian epidemics, and especially not for epidemics of cholera and prevalence of enteric fever among European soldiers serving in India. 4. That to diminish fevers of all kinds, to diminish cholera, and to diminish small-pox—the three greatest forms of Indian disease—the real and only practical remedy is the improvement of local sanitary conditions, largely aided in the case of small-pox by vaccination.

In illustration of what I have said I might give many

examples derived from an experience of nearly twenty years in the Sanitary Department of India, but I have already detained you long enough. I am well aware that the views which I have expressed are not those which are generally accepted or which are generally acceptable to the medical profession, but I can say that they are the result of an honest endeavour made during many years to arrive at the truth. I advance them in no spirit of dogmatism, for I feel that the subjects to which they refer are beset with difficulty, and that it is only by a patient and persevering analysis of the facts that we can ever hope to frame those wise measures which are best calculated to prevent disease.

*Postscript.*—Here my paper, as I wrote it some days ago, ended, but since then news has arrived that cholera has broken out in Damietta and in other parts of Egypt, and all that I have said acquires an immediate importance which I had not anticipated. I prefer to leave what I have written untouched; but there are two questions which the cholera in Egypt suggests, and to which I would ask your attention for a very few minutes. How did the cholera appear in Egypt? and secondly, What can be done to arrest it? In reply to the first question, the believers in the cholera germs will no doubt say that it must have been brought from India somehow or other. We shall see hereafter what proof can be advanced in favour of this idea. Certainly there is nothing very tangible, or we should have heard of it long ere this, and the British Government would have been upbraided, as it has already been, for allowing the cholera to get out of India. If the Sanitary Boards are to justify their very existence, they must prove that cholera was brought from India, either directly or indirectly, and that their quarantine failed only because it was not sufficiently stringent. It will be time enough to examine the supposed facts when they are announced, but there is one important fact which is worth all the theory in the world, and that is, that the cholera broke out not at Suez or along the Suez Canal, or at any port of the country through which the Indian traffic passes, but at the remote and decayed port of Damietta, where there is no Indian traffic at all. And there is another fact, that all along the line of Indian traffic from Suez upwards, so far as we yet know, there has been no cholera at all. But the second is the more important question, and that is, What ought to be done? Results have already shown this, as I knew they would, that quarantine cannot keep out cholera, and that sanitary cordons, as they are miscalled, are perfectly powerless to isolate it. The misery, and alarm, and mischief in

every form that must be caused by all that is being done in Egypt under the misnomer of sanitation is sad to think of. It is indeed lamentable, in this nineteenth century, to read of soldiers with fixed bayonets attempting to stay the cholera; they might just as well attempt with fixed bayonets to stay the wind, or the rain-cloud, or the thunderstorm. These Sanitary Boards are indeed, I firmly believe, doing more harm than the cholera itself. The only real preventive of cholera, as I have already said, is sanitary improvement of every kind, and I trust that the lesson which this epidemic so forcibly teaches may not be lost. Every effort should be made to put our house in order in case the storm comes, and to collect information to guide us in future epidemics. If the cholera should come, it will come first in isolated cases, and it is of the highest importance that the most complete account of these cases should be recorded.

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# PHTHISIS, BRONCHITIS, AND PNEUMONIA: ARE THEY EPIDEMIC DISEASES?

By G. B. LONGSTAFF, M.B.

(*Read: April 4th*, 1883.)

Some explanation is perhaps needed for this evening calling your attention to diseases which are not usually admitted to be epidemic in character.

My reasons for doing so are briefly twofold. First, to fully understand epidemic diseases, it is well to contrast their behaviour with that of diseases of the non-epidemic class; and in these days, when great epidemics are few and far between, we may well turn our attention to the principal causes of death that are always active in our midst. To phthisis, bronchitis, and pneumonia are attributed almost exactly one-fourth of all the deaths in this country.

Secondly, Koch's discovery of the tubercle bacillus has set all men a-thinking, while the proceedings of that most excellent institution, the Committee for the Collective Investigation of Disease, remind us that the idea that pneumonia is an epidemic disease is gaining ground. The question naturally arises, Is bronchitis wholly above suspicion?

As in previous papers, I shall to-night deal with the statistics of mortality in England and Wales, as furnished by the Registrar-General's Department, and with those statistics alone. The numbers of deaths are taken from the Table of Causes of Death in each year's annual report, the "Supplementary Table" being used in every case to correct the classification as far as possible; and the death-rates have all been "ground out" again by Thomas's machine, the corrected values being interpolated between the successive census numbers (this has not been done in many of the Registrar-General's Tables). The results obtained by these processes it is believed may be relied upon, though in such a mass of figures small errors may have been overlooked.

A comparison of the curves that result from plotting out the death-rates from the majority of alleged causes, both with one another and with curves representing various meteorological elements, has led me to classify diseases into four groups.

These groups may shortly be called hot diseases, cold diseases, dry diseases, and indifferent diseases. The indifferent diseases show no marked relation to meteorological fluctuations. This is a residual class of doubtful extent. As Messrs. Buchan and Mitchell have shown, most diseases show a seasonal or week-to-week fluctuation which bears some more or less direct relation to weather; but in the case of some, which, like small-pox, measles, and whooping-cough, show a very marked and constant fluctuation of this kind, no similar fluctuation is observed from year to year. For instance, measles is most fatal in summer and in winter, but we do not find it especially fatal in hot summers or in cold winters. By hot diseases I mean those which are most fatal in summer, and as a rule especially fatal in very hot summers. Examples of this class are diarrhœa, want of breast milk, atrophy and debility, tabes mesenterica, thrush, enteritis, dysentery. By cold diseases I mean those which are most fatal in winter, and more especially in severe winters; the class includes most affections of the respiratory organs, apoplexy, paralysis, mortification, heart disease. By dry diseases I mean those that are greatly checked by rainfall, especially frequent rainfall. Such are scarlatina, puerperal fever, erysipelas, acute rheumatism, laryngitis; this class and hot diseases overlap to some extent.

It must not for one moment be supposed that it is alleged that heat, cold, or drought are the causes of these diseases—what is meant is merely that fluctuations in the various meteorological elements correspond more or less closely with fluctuations in the various death-rates. They are then favouring or predisposing conditions. Thus, for instance, on the average the mortality from scarlet fever will be greater in a dry than in a wet season. More will die of bronchitis in a cold winter than in a mild one; more of diarrhœa in a hot summer than in a chilly one.

Of what use, it will be asked, are researches which lead to conclusions that are familiar to all? *Parturiunt montes, nascetur ridiculus mus.*

The answer is twofold:—1. This classification groups together diseases that were supposed to have no etiological connection, and conversely separates diseases that were supposed to be allied. 2. The connection between the meteorological elements and the death-rate is much less close than might have been expected. This is markedly the case with bronchitis and diarrhœa. There are, then, indications of a residual phenomenon, and all are aware of the importance of indications of such a nature.

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I claim, then, for my method of research that it brings into play all the four inductive methods, but that it does so imperfectly; and that only inductions of but slight probability can be drawn from it, no one is so well aware as myself.

In all the charts laid before you, please to note that the ups and downs indicate percentage fluctuations from the mean. Hence all the curves may be said to be strictly comparable, or drawn to one scale. The actual mean number of deaths is indicated by figures on the right-hand side. One of my first objects in this investigation was to compare together all those alleged causes of death in which the respiratory organs are more or less involved, or in which the fatal issue is commonly due to pulmonary complications, as measles and whooping-cough. Another was to compare the various causes which are, or have been supposed to be, connected with tubercles.

For the first of these purposes the following causes of death have been carefully studied:—Laryngitis, œdema glottidis, croup, measles, whooping-cough, influenza, bronchitis, asthma, emphysema, pneumonia, pulmonary congestion, pulmonary apoplexy, pleurisy, empyæma, phthisis, hæmoptysis.

For the second:—Phthisis, hæmoptysis, tubercular peritonitis, tabes mesenterica, tubercular meningitis (called hydrocephalus in the returns), scrofula, psoas abscess, joint and bone disease, rickets.

As might have been expected, most of this labour was thrown away, and from the majority of the above curves little was to be learned—chiefly owing to the smallness of the numbers dealt with, but partly owing to difficulties of classification.

I will now call your attention to diagram No. 1, and to the upper portion of it. The facts apply to England and Wales, and the curves show the annual fluctuations of the death-rates from phthisis, bronchitis, and pneumonia, and some more or less allied diseases throughout a period of twenty-five years.

At the top of the diagram are two curves, coloured grey and black, which represent respectively the death-rates of two typical epidemic diseases, measles and whooping-cough, which have one character in common, viz., that when they kill the patient, the fatal issue is commonly the result of pulmonary complications. Two points will be noted with respect to the curves of measles and whooping-cough. 1. The fluctuations are greater than those of the other curves on the diagram. 2. The curves bear no resemblance to one

another, nor to any of the others. From these facts we are justified in drawing two inferences:—(A) That whatever influence inclement seasons may have on the mortality from whooping-cough and measles, that influence is quite outbalanced by other considerations, viz., the prevalence or otherwise of the infective poison, its varying potency, and the number of susceptible individuals. (B) Since the curves of phthisis, bronchitis, and pneumonia do not exhibit such wide fluctuations, there is a presumption *pro tanto* that these latter are not epidemic diseases, at all events in the sense that measles and whooping-cough are.

Now look at the green line representing the mortality from phthisis. Two points catch the eye at once. 1. It has a tendency almost uniformly downward. 2. It does not deviate much from a straight line.

As to its tendency downward, it must be borne in mind that the death-rate from respiratory diseases and phthisis taken together has risen over 5 per cent. during the last twenty years, while that from phthisis has been falling 20 per cent. We shall probably be near the truth if we attribute the apparent decline mainly to points of diagnosis and nomenclature.

The approximation of the curve to a straight line is remarkable. No other cause of death gives a straighter curve; but those of cancer, apoplexy, paralysis, convulsions, and fractures are about equally straight. Messrs. Buchan and Mitchell have shown that in London the maximum death-rate from phthisis occurs in the eleventh week of the year, being then 13 per cent. above the mean, whereas the minimum death-rate occurs in the thirty-seventh, thirty-eighth, and thirty-ninth weeks, being then 12 per cent. below the mean, or a total range of 25 per cent., a smaller range than in any other disease, except cancer and premature birth.

This straightness of both the week-to-week and the year-to-year curves of phthisis is, I think, a very remarkable fact. Anyone would naturally have supposed that severe weather would influence the phthisis death-rate to a much greater extent than is actually the case; but it would appear that the inexorable diseases, phthisis and cancer, keep their victims alive, so to say, till they have finished with them, jealously resenting any interference. Of course the very chronic character of these diseases to a great extent explains this. Those who believe in the communicability of phthisis would probably explain by this same chronic character the fact that it exhibits none of the characteristics of an epidemic disease.

The curves of tubercular meningitis and tabes mesenterica are inserted, to show that in several respects they resemble those of phthisis. Such a resemblance was not observed between these curves and that of scrofula. The two red curves are drawn to a common mean, and exhibit the phenomenon of two almost identical curves, differing mainly in the fact that one has an upward, the other a downward tendency. The explanation is easy, for it is well known that many deaths are now returned as due to chronic bronchitis, which in former times were attributed to asthma. It is probably a mere question of nomenclature.

But although fewer deaths are now attributed to asthma than formerly, the transfer of these to bronchitis will not account for the great rise in that curve.

*Average Death-rates per million.*

| | 5 Years—1855-59. | 5 Years—1875-79. |
|---|---|---|
| Bronchitis | 1359 | 2465 |
| Asthma | 238 | 116 |
| Asthma and bronchitis | 1597 | 2581 |

Or an increase of 62 per cent.

Neither will the decrease in phthisis and pneumonia altogether account for the increase in bronchitis, although it will to a great degree, as the following table shows:—

*Average Death-rates from certain Diseases in England and Wales per million.*

| | 5 Years. 1855-59. | 5 Years. 1875-79. | Rise or Fall per cent. |
|---|---|---|---|
| Phthisis | 2648 | 2117 | −20 |
| Bronchitis | 1359 | 2465 | +81 |
| Pneumonia | 1294 | 1035 | −20 |
| Other lung diseases | 502 | 483 | −4 |
| Total | 5803 | 6100 | |
| Increase | | 297 | per cent. +5 |

It must be admitted that more persons die now from diseases of the respiratory organs than did twenty years ago. Probably the diminution in the mortality of infants from exanthemata will account for this. Delicate persons (indeed, all persons must die of something) and weaklings who escape a pestilence may be expected to fall victims to so-called inflammatory diseases.

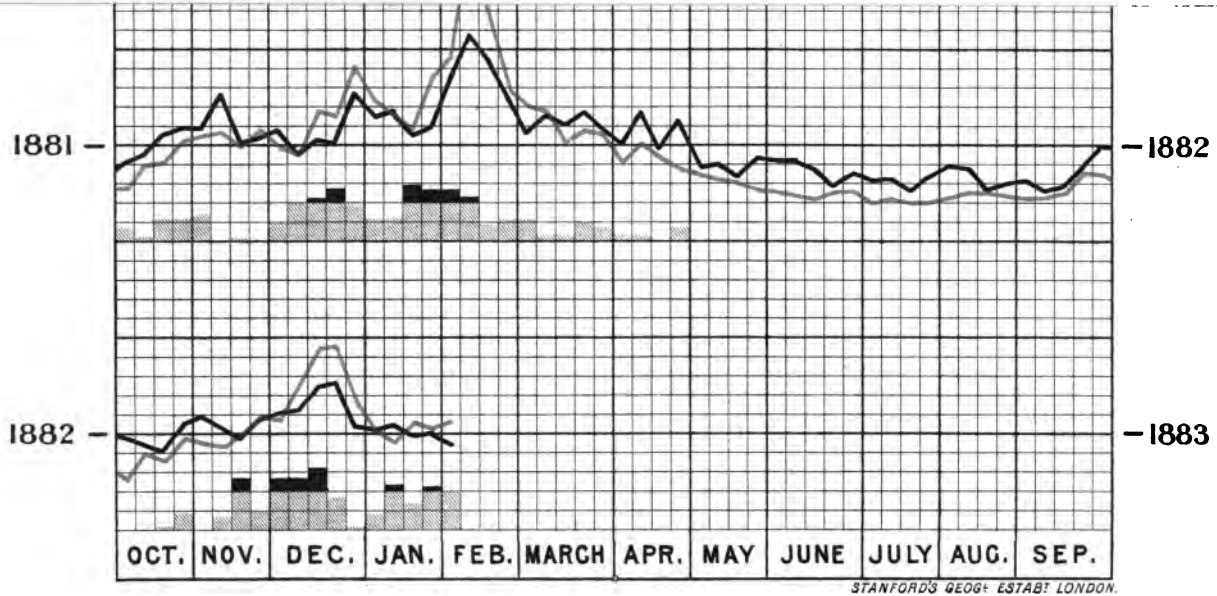
Reverting to the diagram, the dark-blue curve, pneumonia, shows a downward tendency, though not so marked as in

the case of phthisis. In amplitude its fluctuations are midway between those of phthisis and bronchitis; but they correspond in direction very closely with the latter. The pleurisy curve is in some points allied to the pneumonia curve; but it resembles far more closely that of "rheumatism of the heart", which in turn, as I showed in a former paper, has a very remarkable resemblance to the erysipelas curve. Messrs. Buchan and Mitchell called attention to the fact that the week-to-week fluctuations of pleurisy resemble more closely the corresponding fluctuations of rheumatism, than they do those of respiratory diseases.

May we not conclude from these two facts that the majority of deaths assigned to pleurisy have their origin in rheumatic fever, rather than in inflammation induced by cold?

Turn now to the lower portion of the diagram. It seems more natural, in studying a winter disease, to adopt a method of dividing the year which shall avoid the inconvenience of cutting every winter in half. The plan that commended itself to me as most convenient for this purpose was to make the year commence with the present fourth quarter, or October 1, a period that very nearly corresponds with the first rise of the curves of winter diseases from the summer minimum. This method is only applicable to the statistics of London. The death-rates from phthisis, bronchitis, and pneumonia are given in the same colours as above, and the resulting curves will be found to be very similar to those for England and Wales. The black curve indicates the number of cold days at Greenwich in each year—calling a cold day one on which the mean daily value of the temperature of the air was 40 deg. Fahr., or lower. This curve resembles those for bronchitis and pneumonia in many respects, but not so closely as might have been expected. Several other measures of the coldness of the winters have been tried, but the one adopted corresponds more closely than any other with the mortality due to the two great inflammatory diseases of the breathing organs.

The smaller diagram shows the weekly fluctuations of the deaths from bronchitis and pneumonia in London during the past five winters—three of exceptional severity and two very mild. The death-rates have not been calculated, but the curves all express fluctuations from the mean weekly number of deaths for the five years. The shaded squares indicate the mean weekly "cold" (if one may be allowed the expression); the pale shading corresponding to temperatures between 40 deg. and 50 deg. Fahr., or what is usually called "raw"




*Each small division of the vertical scale corresponds to ten per cent. of excess or defect from the Mean.*

*The grey shaded squares indicate mean weekly temperature at Greenwich below 50°F.*

*The black squares in like manner indicate mean temperature below 40°F. Each division of vertical scale corresponding to 5°F.*

weather; the black to temperatures between 20 deg. and 40 deg., or "frosty" weather.

It will be noticed (1) that the pneumonia curves (black) correspond generally with the bronchitis curves (red), but deviations from the mean are much smaller in the case of the former. 2. While the pneumonia curves rise in the autumn as rapidly as those of bronchitis, they subside more slowly in the spring. 3. Long-continued cold raises the mortality, from both causes, more than lower temperatures lasting a shorter time. 4. In the spring of 1879 there was prolonged high mortality from both bronchitis and pneumonia out of all proportion to the severity of the cold. 5. In the winter 1878-9 the correspondence between the two curves is much less than in the others. It should be explained that the extraordinary mortality in February 1880 and 1882 followed intense frost that was accompanied by dense smoky fogs. But I have not been able to prove that fog *per se* has the effect that might be expected.

In the third diagram* the two blue lines at the top are the phthisis curves during the two severe winters 1878-9 and 1879-80. It will be seen at once that the severe cold had an insignificant effect upon the mortality. The curves are, however, much more like the pneumonia curves than those of bronchitis. The remainder of this diagram is occupied with curves traced from Messrs. Buchan and Mitchell's figures, and apply to averages of thirty years, 1845-74. Measles and whooping-cough are seen to have very characteristic curves, quite dissimilar to each other, and I may add all others. Tubercular meningitis is again seen to be allied to phthisis, but tabes mesenterica is a summer disease mainly. Asthma and bronchitis are closely allied. Pneumonia looks like a compound curve having a secondary spring maximum. Pleurisy and rheumatism are very similar, but, owing to the smallness of the numbers, both are very jagged.

Pneumonia is one of those diseases in which the question of sex has to be considered when discussing its etiology.

For every 1,000 females that died in 1880:—

| | | |
|---|---|---|
| From all causes . . . | 1,131 | males died. |
| From phthisis . . . | 1,046 | „ „ |
| From bronchitis . . . | 1,104 | „ „ |
| From pneumonia, no less than . | 1,460 | „ „ |

This great difference points to occupation and habits. Intemperance is no doubt a factor, but the difference between bronchitis and pneumonia is very striking.

* It was not considered necessary to incur the expense of reproducing this diagram.

*Influence of Geographical Distribution.*

BRONCHITIS.—MEAN DEATH-RATE IN COUNTIES, 1876-80 (PER 1,000,000).

| | | Per cent. of E. and W. | | | Per cent. of E. and W. |
|---|---|---|---|---|---|
| Lancashire ... ... | 3460 | 145 | Essex ... ... ... | 1918 | 80 |
| Metrop. Surrey ... | 3241 | 136 | South Wales ... ... | 1906 | 80 |
| Metrop. Middlesex ... | 2997 | 126 | Hereford ... ... | 1901 | 80 |
| West York ... ... | 2913 | 122 | Northumberland ... | 1891 | 79 |
| Warwick ... ... | 2891 | 121 | Huntingdon ... ... | 1869 | 78 |
| Monmouth ... ... | 2713 | 114 | Oxford ... ... | 1862 | 78 |
| Notts ... ... ... | 2662 | 111 | Salop ... ... .. | 1858 | 78 |
| Stafford ... ... | 2550 | 107 | Bucks... ... ... | 1840 | 77 |
| Cheshire ... ... | 2506 | 105 | Rutland .. ... ... | 1768 | *c.* 74 |
| Cumberland ... ... | 2463 | 103 | Herts ... ... ... | 1764 | *d.* 74 |
| Metrop. Kent ... ... | 2423 | 101 | Hants ... ... ... | 1790 | *a.* 75 |
| Derby ... ... ... | 2375 | 99 | Berks ... ... ... | 1771 | *b.* 74 |
| Leicester ... ... | 2196 | 92 | Westmoreland ... | 1700 | *f.* 71 |
| North York ... ... | 2182 | 91 | Beds ... ... ... | 1707 | *e.* 71 |
| Wilts ... ... ... | 2177 | 91 | Kent, Extra Met. ... | 1668 | 70 |
| Durham ... ... | 2177 | 91 | Suffolk ... ... | 1664 | 70 |
| Somerset ... ... | 2123 | 89 | Cornwall ... ... | 1627 | 68 |
| Devon ... ... ... | 2057 | 86 | Sussex ... ... | 1620 | 68 |
| North Wales ... ... | 2053 | 86 | Norfolk ... ... | 1578 | 66 |
| Worcester ... ... | 2038 | 85 | Surrey, Extra Met. ... | 1542 | 65 |
| East York ... ... | 1994 | 84 | Cambridge ... ... | 1462 | 61 |
| North Hants ... ... | 1953 | 82 | Gloucester ... ... | 1263 | 53 |
| Lincoln .. ... ... | 1936 | 81 | | | |
| Dorset ... ... ... | 1925 | 81 | England & Wales ... | 2388 | |
| Middlesex, Extra Met.. | 1918 | 80 | | | |

Registration counties in which pneumonia is comparatively much more fatal* than bronchitis:—South Wales, Gloucester, Rutland, Extra Metropolitan Surrey, Bedford, Cornwall, Monmouth, and Cambridge.

Registration counties in which bronchitis is comparatively much more fatal* than pneumonia:—North York, Warwick, Wiltshire, Metropolitan Surrey, Cumberland, Nottingham, Westmoreland, Cheshire, Somerset, Oxford.

I am by no means anxious to force conclusions from the meagre facts thus laid before you; but, nevertheless, I venture to propound the following propositions for discussion:—1. The mortality statistics of England and Wales throw no light upon the question of the communicability of phthisis, but the evidence, so far as it goes, is negative. 2. Cold weather has but very little influence on the phthisis death-rate. 3. The bronchitis death-rate is greatly affected by temperature,

* More than 15 per cent.

*Influence of Geographical Distribution.*

PNEUMONIA.—MEAN DEATH-RATE IN COUNTIES, 1876–80 (PER 1,000,000).

| | | Per cent. of E. and W. | | | Per cent. of E. and W. |
|---|---|---|---|---|---|
| Lancashire .. ... | 1395 | 139 | Middlesex, Extra Met.... | 840 | 84 |
| Monmouth ... ... | 1330 | 132 | Kent, Extra Met. .. | 829 | 83 |
| S. Wales ... .. | 1254 | 125 | Berks ... ... ... | 814 | 81 |
| W. York ... | 1237 | 123 | Herts ... ... ... | 806 | 80 |
| Stafford ... ... | 1222 | 122 | Salop ... ... ... | 803 | 80 |
| Metrop. Middlesex ... | 1197 | 119 | Cumberland ... ... | 803 | 80 |
| Metrop. Surrey ... | 1131 | 113 | Essex ... ... ... | 796 | 79 |
| Rutland ... ... | 1078 | 107 | Cambridge ... ... | 778 | *b.* 77 |
| Metrop. Kent ... ... | 1069 | 106 | Suffolk ... ... ... | 773 | *c.* 77 |
| Leicester ... ... | 1048 | 104 | Dorset ... ... ... | 781 | *a.* 78 |
| Derby ... ... ... | 987 | 98 | Northumberland ... | 768 | 76 |
| N. Wales ... ... | 959 | 96 | Lincoln ... ... ... | 745 | 74 |
| Devon ... ... ... | 958 | 95 | Norfolk ... ... ... | 735 | 73 |
| Warwick ... ... | 954 | 95 | Somerset ... ... | 728 | 73 |
| Huntingdon ... ... | 935 | 93 | Hereford ... ... | 728 | 73 |
| Worcester .. ... | 934 | 93 | Sussex ... ... ... | 680 | 68 |
| Durham ... ... | 927 | 92 | Wilts ... ... ... | 669 | 67 |
| North Hants ... ... | 925 | 92 | Hants ... ... ... | 668 | 67 |
| Gloucester ... ... | 921 | 92 | Bucks ... ... ... | 650 | 65 |
| Notts ... .. ... | 919 | 92 | Oxford ... ... ... | 622 | 62 |
| E. York ... ... | 915 | 91 | N. York ... ... ... | 597 | 59 |
| Beds ... ... ... | 902 | 90 | Westmoreland ... ... | 541 | 54 |
| Cheshire ... ... | 897 | 89 | | | |
| Cornwall ... ... | 872 | 87 | England and Wales ... | 1004 | |
| Surrey, Extra Met. ... | 854 | 85 | | | |

that of pneumonia also, but not quite so markedly. 4. It is difficult to explain, by meteorological phenomena only, all the fluctuations of the mortality from bronchitis and pneumonia. 5. The diagrams do not give any support to the theory of pneumonia being a disease allied to typhoid fever. 6. Although the facts do not exclude the possibility of a communicable pneumonia having no connection with cold, they show that such a theory can account for but a very small proportion of the deaths attributed to pneumonia. 7. While the mortality from pneumonia, and more especially from bronchitis, appears to be mainly regulated by intense cold, by fogs, and the cold winds of early spring, the occasional want of correspondence between the assumed causes of the effects suggests that possibly bronchitis and pneumonia, or many of the cases so designated, may be communicable, or they may be complications of a communicable disease, more or less fatal according to the prevailing meteorological conditions. 8. Many domestic incidents suggest that

common catarrh, or some form of it, is more or less communicable. Is this communicable catarrh, assuming it to exist, a mild form of influenza? and are many cases of bronchitis and pneumonia to be regarded as serious complications or sequelæ of that neglected but most troublesome ailment? 9. The fact that whereas 1,104 males die from bronchitis to every 1,000 females, but as many as 1,460 males die from pneumonia to every 1,000 females, suggests that the cause of the two diseases is different. 10. The curves suggest a common factor in the two diseases, phthisis and tubercular meningitis.

This inquiry has been less productive of positive results than I expected, but if it contributes either to clear away false notions or to indicate lines of future research, it may not be wholly labour lost.

# THE INFLUENCE OF SMALL-POX HOSPITALS.

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(*Read: Dec. 6th,* 1882.)

ABSTRACT.

THE reader commenced by giving a description, illustrated by photographs, maps, and plans, of the kind of hospital accommodation at Nottingham, which was situate quite in the heart of the populous part of the borough. It was of a temporary character, having been erected in a great hurry during the small-pox epidemic 1871-72. It consisted of wooden huts, capable of receiving eighty patients, built in a space of five acres of ground, and divided from frequented thoroughfares only by a wooden fence six feet high. The disadvantages of a hospital so situated and so constructed were obviously great. Much care and attention had been given by those who were concerned in the management, but with such materials it was an impossibility to carry out isolation in the perfect manner that should be expected at hospitals for infectious diseases. In the first place there was no suitable provision for a resident medical officer, who should be there to maintain a constant and intelligent supervision, and to exercise absolute and undivided control over the establishment and its inmates. Being also very centrally placed, some of the private practitioners continued attendance on their own cases at the hospital, and though most of them were very careful to adopt all requisite and practicable precautions, there were some who were not so. The chief drawback was due to the facilities for communication between the convalescents and persons outside over the wooden fence; and when the hospital was full it was exceedingly difficult to prevent this altogether. There was a further drawback to these hospitals, arising from the fact that the Poor-law Authority had a kind of joint proprietorship with the Sanitary Authority, which, at one time, seriously interfered with their proper medical management. It was evident, then, that hospitals of this temporary character, especially

when in the centre of a town, did not allow of isolation being carried out in a sufficiently complete manner. Having been convinced of this by recent experience, he had strongly urged the Town Council of Nottingham to build a permanent hospital away from the central part of the town, and they were at that time proposing to go to Parliament for compulsory powers to enable them to obtain a suitable site in accordance with the recommendations of the Royal Commission.

After dwelling on the great difficulty in tracing cases in town populations, the reader proceeded to give a narrative of the early part of the epidemic, which arose from cases imported into different parts of the town from Loughborough, London, and Derby, and elsewhere, accounting for all the cases which came to his knowledge during the first two months. With one exception, each of these admitted of being so dealt with as to allow little room for the spread of the infection. The exception to which he referred occurred during the fifth week of the epidemic. The symptoms of variola confluens, which was contracted in London, were manifested five or six days after arrival in Nottingham, and during the first few days of illness it was known that fifteen persons had been in contact with the sick person. This case formed a centre of infection situate in a direction north-east of the hospital, and at a distance of more than half a mile. He then referred to certain other cases which came to his knowledge about the same time, and which proved to be prolific centres of infection. One of these was at a little barber's shop. The mother and wife of the barber were attacked with the disease severely, and must have been lying within a few feet of where the customers were shaved. He had good authority, also, for saying that the barber himself suffered from a rash which was believed to be that of modified small-pox, his illness not being sufficient to prevent his pursuing his avocation. Another centre was at a tripe shop, where the person who nursed the patient also waited in the shop. A third, close by, was that of a man who refused to be removed to the hospital, and was afterwards found, with the crusts of small-pox upon him, conversing with people, for which offence he was prosecuted and fined. These three centres occurred within the quarter-mile radius of the hospital. There was a fourth, at a distance of about half a mile east of the hospital—an anti-vaccinator—who was discovered carrying on his business, as a journeyman tailor, whilst an advanced case of confluent small-pox (which he had kept secret) lay in a room which was virtually part of the

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workshop, and who thus became the means of disseminating the disease broadcast. This last-mentioned case, together with the other centre to which he had referred as having occurred during the fifth week of the epidemic, formed the starting-points of an outbreak a long way off, just as the barber's shop and the tripe shop must have been starting-points of the outbreak close to the hospital, on the east and north-east sides. This and other points he elucidated by a series of hand-maps which he had prepared, showing the gradual development of the epidemic. The maps showed the hospital as a centre, circles being drawn to indicate the quarter-mile, half-mile, three-quarter-mile, and mile radius. The cases were shown by spots of three different colours—dark blue, light blue, and red. The dark blue indicated those which were kept at home badly isolated; the light blue, those kept at home fairly well isolated; the red those removed to hospital. This division was of course somewhat arbitrary. The isolation was not equally bad in all the cases indicated by dark blue spots; and among the cases indicated by red spots were many which were promptly removed to hospital as soon as the symptoms of the disease were manifest; and others in which there had been opportunities for the spread of the disease before removal took place. Still, the different coloured spots served to indicate roughly the relation of cases. There were in all eight hand-maps. Five of these referred to different periods of the epidemic; the first, comprising cases 1 to 100, from November 24, 1881, to March 8, 1882; the second, 101 to 200, March 8 to May 1, and so on. Between the first and the second there was an intermediate map, A, showing the first 183 cases, November 24, 1881, to April 26, 1882. Then there was a map showing those of the whole 500 cases, from November 24, 1881, to November 7, 1882, which occurred within the mile radius. The eighth map referred to the epidemic of 1871-72. By the help of these maps a lesson might be learnt as to the value of an Isolation Hospital in checking the spread of small-pox. Taking Map A, which showed those of the 183 cases occurring within the circles during the first five months, it would be observed that they were mostly grouped near to badly isolated cases. A dark blue spot was almost always followed by a crop of other spots; on the other hand, red spots occurring in other localities stood alone. As he had already said, it would be seen from this map that the cases east of the hospital were arranged in two principal groups, which had relation to recognised centres of infection. These groups were separated by a broad belt of populous district, almost entirely clear,

with the exception of one little secluded terrace of houses, about which the disease hung for months. The relation of this cluster of spots to a blue spot as a starting-point seemed very evident. These groups—two large and one small—had occurred on the east side of the hospital, and the prevailing wind during the first five months of the epidemic was from the west. This had given rise to the supposition that the infection was carried in the atmosphere from the hospital as a centre; and in view of Mr. Power's admirable report recently made public, it was necessary to examine the facts closely to see whether they fitted in with this hypothesis. Apart from the relation of the cases to recognised centres of infection, there were other considerations which directly negatived this supposition. In the first place, the number of cases was greater in the group near to the half-mile ring, and between that and the three-quarter-mile ring, than close to the hospital. In the second place, there had been no simultaneous outburst of cases, such as might have been expected had the semina of small-pox been widely scattered in a still active state amongst a population which was proved to be susceptible. He had five maps, on a large scale, hung in the room, showing the position of each case as it occurred, the date of its occurrence being also indicated by a number; every case thus appeared as it presented itself in point of time. He would not attempt to go through the various groups of cases which made up the epidemic; he would, however, select one group as illustrating the others. It was that in the little secluded terrace, and in houses immediately adjoining, already referred to. The cases recorded here, within a few yards of each other, were numbered 39, 44, 57, 68, 94, 99, 136, 153; the corresponding dates being January 30, February 8, 16, and 22, March 4, 8, and 29, April 3. Now, this little cluster formed, up to the end of the first five months of the epidemic, a small independent group between the two large groups. The whole of the circumstances pointed to the fact that they arose from direct or intermediate communication between infected and non-infected persons. On the other hand, the hypothesis of atmospheric dissemination required us to suppose that the small-pox material, in process of being conveyed by the atmosphere in an easterly direction to the locality at the extremity of the half-mile radius, passed over unharmed the belt of populous district which intervened between the two large groups, and showed a special affinity for this particular spot; and not only so, but that it should have given evidence of its power for mischief by attacking the persons living there at different

times. The opportunities he had of seeing the way in which the cases arose led him to attach much importance to these considerations. He then drew attention to a large map of the borough, into which glass-headed pins were stuck to indicate the cases in the localities where they occurred—the first 183 being shown by black-headed pins, and the rest of the five hundred by pink-headed pins. It would be seen that there were very few black-headed pins near the hospital on the south side—not so many as those beyond the mile radius, which indicated some of the very earliest cases of the epidemic. East and north-east of the hospital they were massed in groups as already described. The pink pins were pretty thick south of the hospital, and also plentifully interspersed among and between the groups on the east. It would be seen, then, that during the first five months the south side was nearly free from small-pox, but that subsequently it became invaded. To account for this, much importance had been attached to the direction and force of the wind, which was chiefly from a westerly direction till the end of March, and during April and May from a northerly quarter. But, independently of all other considerations which were entirely opposed to this view, there was the fact that though the wind blew sometimes from the north, the susceptible population near to the hospital on the south were more free from the disease during all these months than localities widely distant. Besides, according to recent observations, it was not windy, but calm, misty, foggy weather which was favourable to the dissemination of small-pox material; and, assuming this to be so, the difficulty was to explain the immunity of the south side, seeing that there were twenty-eight days recorded as calm, misty, or foggy, during the five months.

The reason for the exemption of this district seemed to him quite clear; it was this—that the few cases occurring south of the hospital within the quarter-mile, half-mile, and three-quarter mile rings, were promptly reported, and in every instance the official staff was successful in getting them removed to hospital. This was shown in map A, where the cases were all indicated by red spots. At the end of April a case of small-pox was imported into the district; it was kept at home throughout the illness. He drew the attention of the Health Committee to this case when it occurred. For certain reasons it could not be removed to hospital, and the isolation was about as bad as it could be. Three other unvaccinated children in the same house were subsequently attacked. Now, this group of cases at the end of April

constituted a prolific centre of infection on the south side, just as the barber's shop, in January, must have been the starting-point of much of the small-pox near the hospital on the east. He had told the Committee at the time that they must anticipate a spread of the disease in this direction; and during the summer, as the maps showed, a large proportion of the cases appeared on this side.

The reader then went on to describe the hand-maps further in detail. As a rule, the blue spots were followed by a crop of other spots, but there would be seen to be some exceptions to this rule. It would be remarkable if it were not so, seeing that they had in vaccination an influence controlling the spread of small-pox more powerful than that of isolation. Whenever small-pox made its appearance in a locality, the Sanitary Authority urged revaccination not only on the household, but on the neighbours. In order to facilitate this, lymph freshly taken from well-chosen cases was furnished to practitioners for the purpose of revaccinating those who required it, and who were likely to be exposed to infection; and where medical men had certified that the persons were not in a position to pay the fees for these revaccinations, the Sanitary Authority had, with a wise liberality, made it a rule to pay for them at the rate of 2*s.* 6*d.* each. Still, with all these arrangements, there was the greatest possible difference in the way in which vaccination was pressed by different medical practitioners, and this fact, of course, constituted an element of the first importance in determining the spread of small-pox. Then, again, independently of the way in which the desirability of vaccination was put forward by the medical attendant and the officer of the Sanitary Authority, the occurrence of a death from this terrible and loathsome disease would sometimes arouse the people of a neighbourhood to a sense of their folly in neglecting to avail themselves of vaccination. This was all the more so when the case was kept at home, and the people became acquainted with small-pox in all its hideousness, as it occurred amongst the unvaccinated or the badly vaccinated. This led him to speak of one disadvantage that attended the removal of the worst cases to hospital. It undoubtedly did tend to encourage that indifference and repugnance to vaccination which was so sedulously cultivated by anti-vaccinators, and which arose to a large extent from an ignorance on the part of the people as to what small-pox unmodified by vaccination really was. This constituted one of the disadvantages that to some extent counterbalanced the great advantages, from a public health

point of view, of the early removal of cases to hospital. In addition to the action to which he had already referred, he had himself, acting for the Health Committee, done what he could single-handed towards promoting re-vaccination. He had endeavoured to bring this about by addressing meetings of the working people at the factories on the subject, and, at the same time, providing exceptional facilities for good "arm-to-arm" vaccination, free of cost, at the factories. In some instances, being backed up enthusiastically by large employers of labour, he had succeeded in getting numbers of lace-girls over fifteen years of age, and other factory hands, revaccinated, and in this manner the progress of the disease must have been interfered with very much.

With all these disturbing elements, if he might so term them, it was not to be expected that the spread of the epidemic would be uniformly in proportion to the badness of the isolation, or that there should be any mathematical relation between the number of blue spots to the total number of spots in a given locality. Still, on looking through the series of maps, they would see that the localities in which badly isolated cases occurred almost always became the seats of a further outbreak. The exception to this general rule seemed to be most marked in the fourth map of the series, which comprised the one hundred cases occurring between June 12 and July 7, and also in the fifth, which comprised the last hundred, the most of which occurred in July. Here they had, in the season of the year, another important controlling influence, of a nature as yet little understood. For though during July and August nearly all the cases were promptly removed to hospital, there were a few outside, which at another period of the year would certainly have proved active centres of infection. He could not, therefore, ascribe to hospital influence more than a share in bringing about the almost complete cessation of the epidemic in September; though he was disposed to think that share was a very large one, having regard to the very large proportion of susceptible persons in the borough. Here he might ask—How was it that small-pox did not spread so rapidly at one time of the year as another? How was it that in one epidemic it would assume a much more malignant form than in another? How was it that measles, a few years ago, attacked Plymouth with such virulence, while at the same time the disease prevailing extensively amongst a population of presumably the same susceptibility, at Nottingham, caused a serious but comparatively small mortality? Why was scarlet fever so terribly fatal in Hull about a year ago? By the light of

present knowledge these anomalies could be only partially accounted for. The science of epidemiology had yet to solve these and many other mysteries. In the meanwhile, with regard to small-pox, this much can be said for certain, that it is practically preventable by vaccination and re-vaccination *properly* performed, if the people would only avail themselves of these safeguards. In isolation hospitals there is also another means of prevention, which, for various reasons, must, he thought, at the present day be considered indispensable.

The last map of the series showed the whole of the cases which occurred from November 24, 1881, to November 7, 1882, within the mile radius, in relation to cases kept at home as well as in their relation to hospital. It was important to note that, though the total number of cases appeared to show a relation to their distance from the hospital, they also bore a relation to the number of centres of infection within the four circles. The relation was not a definite one, and would not be expected to be so, for reasons already stated, but it was obviously a prime factor for consideration in determining the question of atmospheric dissemination.

He had not as yet had the opportunity of alluding to a very probable source of infection in some of the first cases which he had referred to as starting-points of the outbreak, near to the hospital. It arose from one of those very slight cases of modified variola which are best described as "ambulatory small-pox", and which, as we know, are so often fruitful sources of mischief in a way which, at present, it would appear impossible to prevent. The person so suffering, who lived near the hospital, and also close to where the subsequent cases arose, must have taken small-pox at the end of November or beginning of December 1881, when there was only one case of small-pox in the hospital. Unless it were supposed that this man contracted his illness from this one case through the atmosphere, he must have got it independently of the hospital, seeing that prior to November 24 it had not been used for small-pox for months, and then only for one case at a time. He was a joiner by trade, and was going about his work as usual whilst in a condition likely to give the disease to others. It would be seen, then, that even at the very commencement of the epidemic there was outside the hospital an independent source of infection, and that very erroneous conclusions might have been arrived at had it been overlooked.

The reader then proceeded to draw attention to certain remarkable exemptions, which could not be well accounted

for on the hypothesis of atmospheric dissemination. The west side of the hospital had been comparatively free from the disease, as compared with the south and east sides, and though it was possible that the population was better protected by vaccination, there was no proof that it was so. Then close to the hospital, on the west, was the union workhouse. The first case of the epidemic made its appearance here on November 24, it being removed to the hospital over the way at once. Whilst at the workhouse the patient was in the "skin ward", with fourteen others. Of these fourteen, seven contracted the disease. There were a few other cases which occurred at the workhouse about this time, and one person died there; but after the commencement of the epidemic, the workhouse, with its 618 inmates, was free from the disease, notwithstanding its close proximity to the hospital, and notwithstanding that there had been very little re-vaccination carried out. In May, another case or two having occurred, re-vaccination was extensively resorted to. On the other side of the road, on the north, is a large board-school. In the boys' department, which is nearest the hospital, there are 410 scholars; two of these only were attacked, and in each there was ample opportunity for the illness to have been contracted in the ordinary way. This immunity, however, did not count for much, seeing that primary vaccination would protect the vast majority of those at school age, and it would be only those who had escaped vaccination who would constitute a test.

But by far the most remarkable case is that of Mr. Hodgson's factory, on the south side. This building is virtually in the hospital ground, the distance being only thirty yards from the nearest hut to the factory wall (photographs shown). Some of the windows on the second and third floors overlook the hospital ground, and a stone might easily be pitched from one of the "doubler's" rooms into one of the hospital huts in which some of the worst cases were put during the epidemic. The factory buildings, however, are enclosed in such a way that there can be no personal communication between the workpeople and the hospital convalescents. During the year two persons working at this factory had been attacked. In one case the source of infection might be said to have been traced with a considerable amount of probability; in the other, it would be quite impossible for anyone to ascertain with anything like certainty the various chances of infection incurred twelve or thirteen days prior to the commencement of illness. When he visited this factory a short while before, it was for the purpose of

finding out whether there were any persons who had not been re-vaccinated. The factory was not one of those at which he had himself addressed the *employés*, but, having regard to its very close proximity to the hospital, and to the danger which was supposed to exist in consequence, he fully expected to find that nearly everyone was protected against small-pox by re-vaccination. To his great astonishment he found that (excepting the Messrs. Hodgson) so far from being the rule, re-vaccination had been the rare exception; that a large number of the workpeople were very badly vaccinated, and that some were unvaccinated. In order to show the proportion of persons who might be looked on as susceptible to small-pox, he had drawn up the following table. In separating the vaccinated but unrevaccinated adults into Classes II and IV, he had been guided not only by the number and size, but also the character of the marks as regards their foveated and depressed condition. This division was, of course, somewhat arbitrary; some of those placed in Class IV might by others have been placed in Class II, and *vice versâ;* but he had tried to represent the facts as fairly as possible.

Now, the number of patients at the hospital huts was at one time as many as seventy-eight. The proportion of acute cases was, of course, constantly varying, but in one week there were as many as thirty-two fresh cases admitted. At the lace factories the work is carried on at night as well as in the daytime. During the eleven months the "hands" must have been working there under every conceivable variation in atmospheric conditions. They were there during the still, cold, foggy weather of December and January, during the early spring, when the high winds blew from the west, in the hot days of June and July, in the still summer evenings, and again in the early morning when the dew was rising from the earth. They were there in damp and dry states of the atmosphere, when the amount of ozone, according to Schönbein's test, was present in large quantities, and again when it was absent; when the electrical condition must also have varied, when the wind was from the north, the south, the east and the west. Had fourteen of these forty-eight persons been for twenty-four hours in the "skin ward" with a case of small-pox, as the people were over the way on November 24, it is highly probable that, as had happened then, about half of them would have contracted the disease. On the hypothesis of aërial infection, and having regard to the close proximity of the hospital, it is certainly very difficult to account for the immunity of these forty-eight persons during the whole epidemic.

HODGSON'S FACTORY.—*Date of Examination, November 13th and 14th*, 1882.

Number of persons examined as to vaccination, 113.

,, refused to be examined, 4 { Said to have good primary vaccination ... ... } 3. { Said to be unvaccinated ... } 1.

Total number employed at date of examination, 117.

Number of persons employed during whole epidemic ... ... ... ... { November 1881, to November 1882 } 90.

Number of persons taken into employ during epidemic ... ... ... ... { Before September 1, 1882 ... } 20 { Since September 1, 1882 ... } 7 } 27.

Total number employed during whole or chief part of epidemic, 110.

Of the 90 employed during the whole time.

(*a.*) Completely or partially protected, 51.

CLASS I.—15.
Adults revaccinated; under 15, with good marks.

CLASS II.—27.
Adults with moderately good marks; under 15, with evidence of vaccination.

CLASS III.—9.
Previous attacks of small-pox.

(*b.*) Unprotected or very slightly protected, 39.

CLASS IV.—34.
Adults with bad marks.

CLASS V.—5.
No marks, unvaccinated.

Of the 20 employed during the chief part.

(*a.*) Completely or partially protected, 11.

CLASS I.—5.
Adults revaccinated; under 15, with good marks.

CLASS II.—6.
Adults with moderately good marks; under 15, with evidence of vaccination.

CLASS III.—0.
Previous attacks of small-pox.

(*b.*) Unprotected or very slightly protected, 9.

CLASS IV.—6.
Adults with bad marks.

CLASS V.—3.
No marks, unvaccinated.

Total number working in the factory during whole or chief part of epidemic, 110.

(*a.*) Completely or partially protected, 62.

(*b.*) Unprotected, or very slightly protected, 48.

In conclusion, the reader exhibited a map which showed the localities in which all the fatal cases occurred during the epidemic of 1871-72. It was impossible for him to do more than this, as, of course, at that time there was no registration or notification of cases of sickness. It would be understood, therefore, that this map had not the same signification as those he had previously laid before them; still it was a very remarkable fact that the deaths from small-pox, which he had indicated by black spots, were chiefly aggregated in localities far removed from the hospital, the immediate vicinity of which, especially on the north and east sides, was remarkably free. This quite coincided with the facts given by Dr. Thorne (*Report of the Medical Officer, Local Government Board,* 1882, page 210), and with the very important statements there recorded of Mr. Burnie and Dr. Bury, medical gentlemen who practised in the neighbourhood at the time, which went to show that though the hospital was fuller during that epidemic than it had ever been on this occasion, there was less small-pox in the neighbourhood than in other parts of the town.

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ON THE

# PLANNING AND CONSTRUCTION OF HOSPITALS FOR INFECTIOUS DISEASES.

By PERCIVAL GORDON SMITH, F.R.I.B.A.

(*Read: Jan. 3rd*, 1883.)

It has been wisely laid down as an essential that, in order to prevent the extension of any infectious disease in a neighbourhood where it has begun, it is important that, in addition to whatever other sanitary measures may be requisite, every practicable endeavour should be made to separate the sick from the healthy. This separation is comparatively easy if means to attain it are taken early, while the number of cases of sickness is still few. Indeed, there are several instances on record where, the first case having been secured, it has reasonably been supposed to have prevented what would otherwise have been an epidemic. Hence, it is important that means of isolating cases of infectious disease should be available within reach of all; that it should be ready beforehand; and that every facility—nay, every encouragement—should be afforded for patients to avail themselves of it;—in fact, that in appearance, and even in name, no less than in administration and management, it should be as little repulsive as possible.

An epidemic hospital must be regarded as a hospital for the prevention of epidemics rather than as a hospital to deal with diseases when they have become epidemic in a district.

There are innumerable instances where the arrangements of a hospital have been left to be determined only after the necessity for it has arisen, when it invariably happens that they are settled in a hurry, without due consideration, and, in fact, under all the influences of panic—influences alike prejudicial directly as well as indirectly to the arrangement and construction of the building, to the patients themselves, and also to the interests of the ratepayers or whoever may have to bear the burden of the cost of the building.

On the other hand, if the hospital is built in anticipation of being needed, it can be constructed with the utmost amount of consideration, with every attention to detail, and, in fact,

with every care which the teachings of experience have shown to be essential to the proper arrangement of a hospital intended for the reception and treatment of individuals suffering from some of the most serious forms of disease.

A hospital for the prevention of epidemics, then, is a hospital intended for the isolation and treatment of patients suffering from any of those infectious fevers which, if not effectually isolated at their commencement, may, and in point of fact occasionally do, spread to numbers of persons in the locality and thus become epidemic.

Hospitals in this sense, therefore, form a most important feature in the "defences" of a sanitary district against invasion by infectious disease; and the Legislature has accordingly given powers to the various sanitary authorities throughout the country to make the requisite provision, in anticipation, for repelling this invasion and for the treatment of patients needing proper isolation.

An outbreak of infectious disease in a locality, besides the actual cost chargeable to the sanitary authority, frequently imposes a vast immediate pecuniary loss on the entire district in which it occurs—a loss possibly twenty, thirty, or even fifty times greater than the cost of building a hospital. It likewise inflicts an infinite amount of individual anxiety and misery as to which it is impossible to name a value. It is the more surprising, therefore, that the degree to which it is possible to prevent the ravages of such an outbreak is at present so imperfectly appreciated by the general public. Were the public to realise the disastrous consequences that result from epidemics, I feel sure that permanent measures, including the provision of proper hospital accommodation, would be far more generally adopted by sanitary authorities, for preventing any occasional occurrence of infectious fever from leading to an epidemic in their district. Any such measure ought to be regarded as a sort of *insurance* against epidemics; the interest and re-payment of any loan that may be contracted in respect of them, together with the irrecoverable expenses, being the annual premium of insurance.

It has recently been stated that out of an aggregate of about 1,600 Urban, Rural, and Port Sanitary Authorities that exist in England and Wales, no more than about 300 of such authorities have taken measures for dealing with infectious diseases by providing for their districts the means of isolating any cases that may occur; and as regards these, Dr. Thorne-Thorne, in his recently-published *Report on the Use and Influence of Infectious Hospitals*, intimates that many of the hospitals that have been thus provided are but ill-adapted to the purpose.

It is not our business this evening to inquire into the reasons for this apparent apathy on the part of those to whom the Legislature has entrusted the responsibility of protecting the public from epidemics. This would undoubtedly form an interesting subject of inquiry. But we will pass on to the special subject with which we are concerned, and consider the various arrangements that are necessary in a hospital for the treatment of infectious fevers according to modern requirements.

I should state that I do not propose to deal with the arrangement of such large hospitals as have been constructed in various parts of the metropolis, where the total number of patients may be reckoned by hundreds. Nor will I enter into the question of the expediency of concentrating at one hospital large numbers of patients suffering under one or several kinds of infectious fever, or of restricting the numbers to a very moderate figure. These are matters which exclusively concern the medical profession, and as they practically affect but few places outside the metropolis, we will proceed at once to consider the arrangement and requirements of the ordinary hospital of an Urban Sanitary District.

Experience shows, that when any particular infectious disease is prevalent in a locality, it is by no means uncommon for a few cases of some other infectious fever to occur about the same time. Moreover, certain infectious diseases are known to prevail at certain periods of the year, while others occur at all times of the year. It not uncommonly happens, too, that one outbreak of infectious fever in a district follows closely on another—the one often commencing before the other has completely ceased. For these and other reasons, it is imperative that any hospital for the treatment of infectious diseases should be so contrived as to admit of the separate and distinct treatment simultaneously, of at least two kinds of infection, and that the arrangements should be such as to allow of this being done with reasonable security that a patient admitted for one disease may not contract another disease consequent upon his stay in the hospital.

It is of little use to design a hospital with the view of reserving the several wards permanently for particular diseases. This has been tried, and found unworkable. For in times of pressure, when one special disease prevails, it is in practice necessary to utilize the wards for whatever purpose they may seem to be best adapted. It is important to bear this in mind, in order that the accommodation may

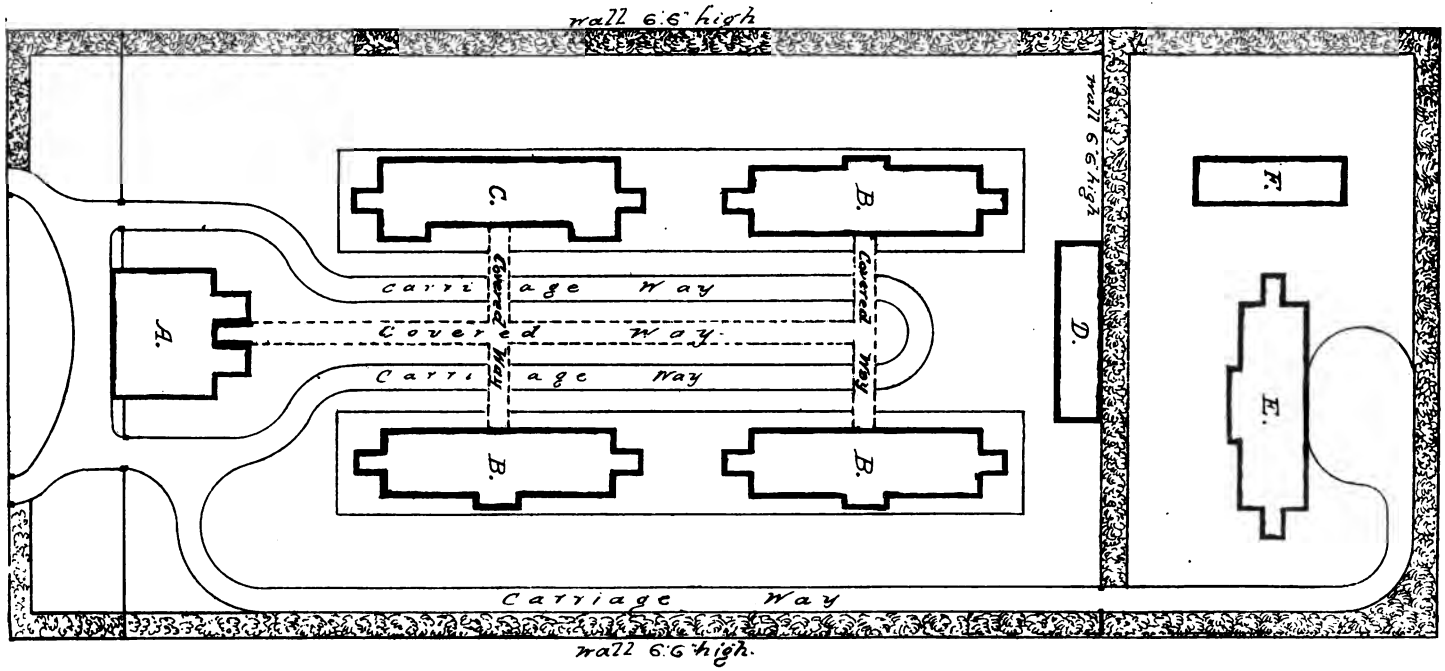
be made available for any purposes, the arrangement generally affording that elasticity which will admit of the larger part of the hospital being used for one infectious fever during a period of prevalence, and for another infectious fever at another period of prevalence, the remaining parts of the hospital sufficing for the requirements of the few occasional cases of other diseases that may come in at the same time and need isolation.

Recent investigations have pointed to the necessity, in the case of small-pox, for the separation just referred to being as complete and effectual as possible. Indeed, it would seem worth most serious consideration whether the entire provision for that disease ought not to be absolutely distinct. Whether, in fact, in the case of hospital accommodation for a large provincial town, it would not be advisable to form two infectious hospitals, one for small-pox, and a second for cases of other infectious diseases. In any case, however, it should be borne in mind, when selecting a site for an infectious diseases hospital, that the area of land for the purpose must be such as will allow of the several blocks of wards being so placed on the ground as to permit of their being at a sufficient distance from the boundaries to prevent reasonable complaint from neighbours, and likewise of their being well separated one from another, in order to prevent as far as possible, intercommunication among the patients and nurses occupying the several ward-blocks. It is, further, most important, for obvious reasons, that all the buildings—whether for patients or administrative purposes—should be so spread about as to secure the most complete free circulation of air and access of sunlight between them. For, seeing that the buildings must depend for ventilation on the space immediately adjoining them, any enclosed and confined areas or courts in proximity to those buildings would only supply stagnant, damp, and otherwise impure air to the interior. For promoting free circulation of air about buildings, it is an excellent plan to raise them on arches some four to five feet above the general level of the ground, or to sink the ground beneath them a few feet, taking care to slope the ground gently down to the lower level. By these means, the confined angle formed by the vertical sides of the building and the ground is obviated, and the free movement of air beneath the building and about its sides is greatly assisted.

A further point to be considered in regard to the extent of site necessary for an infectious hospital is, that something more than sufficient to hold only the requisite buildings themselves is desirable, if not essential. Vacant space is

# BLOCK PLAN

*Showing suggested arrangement for an Infectious Hospital for fifty-four Patients.*




A. Administration Block.
B.B.B Ward Blocks.
C. Isolation Block.
D. Laundry, Mortuary & Ambulance.
E. Small Pox Ward.
F " " Laundry, Mortuary & Ambulance.

occasionally most useful to form a temporary extension of the hospital to meet a more than ordinary outbreak, when tents or huts can be put up in a very short time. Too much importance cannot be attached to this point, inasmuch as when the necessity arises for more accommodation than is afforded by the permanent buildings, it is usually impossible to obtain the requisite additional space; or if possible, it is only so at great cost and inconvenience. The surplus space, moreover, is a most valuable adjunct to the permanent hospital, for it often enables the convalescent patients to be out in the open air more than they otherwise would, thus tending to expedite recovery, while it serves as a great source of enjoyment to the convalescents from some diseases during the two or three weeks' necessary confinement within the hospital before they can be discharged with safety to their friends.

Coming now to the question of actual extent of site for an infectious diseases hospital, for a given number of patients, Dr. Thorne Thorne has pointed out several hospitals where the requisite conditions of construction and arrangement have been fairly met, in which the number of patients to the acre does not exceed twenty. I am strongly of opinion that this number very nearly approaches what should be regarded as the proper maximum number of beds per acre: and while circumstances may render such extent of site sometimes difficult to procure, it is nevertheless, I believe, a proper quantity to aim at securing when seeking for a site for a hospital. I think, moreover, it would be a useful rule to regard the minimum area of site for the smallest infectious diseases hospital as one acre, assuming its shape and levels to lend themselves fairly well to the purposes of a hospital. Where possible, however, it would be useful to secure rather over, than under, that quantity.

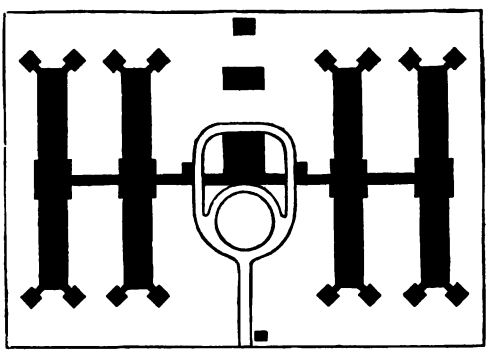
The site must be effectually enclosed with a wall or other close fence, not less than six feet six inches high, and if some sort of double fence can be provided, so as to preclude the possibility of irregular intercourse over the fence between the patients on the hospital premises and their friends outside, it would often be preferable.

With reference to the hospital buildings themselves, they may be divided primarily into three classes—1, the administrative and management; 2, the patients' department; and 3, the various out-offices.*

The administrative department must, in order to be convenient for its purpose, occupy a position easily accessible

* See accompanying block plan, showing suggested arrangements for a hospital for fifty-four patients.

from the patients' buildings, and but, at the same time, conveniently near to the general entrance to the premises. The administrative block is not only the department from which the food and other requisites are supplied to the patients' blocks, but it is here that the official business of the hospital is carried on. The outside public often apply here respecting the admission of patients as well as to make enquiries as to their progress. Tradesmen call here for orders and to bring goods. It is here that the caretakers reside, and it is here that much of the clerical work connected with the hospital has to be done. For all these reasons, it is imperative that the patients should be wholly excluded from this building; and it is desirable so to place it relatively to the patients' blocks that no one approaching it from the outside should come in contact either with patients, nurses, or ward servants. Hence this



Block plan of an Infectious Hospital, showing defective arrangement.

building should stand in advance of the ward-blocks, and be moderately near to the entrance gates. It should have an obvious front entrance, which should be wholly distinct and away from the means of access from it to the patients' blocks.

In this administrative block should be provided the general kitchen, with adequate cooking appliances for the largest number of patients and attendants that can possibly occupy the hospital. Such other domestic offices, scullery, larders, fuel and other stores, etc., as the necessities of the hospital may require, should also be provided here; likewise apartments for the caretaker, a small room for the medical officer, and suitable store-room for dry goods, crockery, linen, blankets, etc. In an upper storey should be provided adequate bedroom accommodation for the nurses and attendants,

for it is most undesirable that the nurses should sleep in the patients' blocks, inasmuch as when on duty they ought to be in the wards, and when not on duty, the quiet needed for their rest, and health considerations generally, demands that they should be away from the infected atmosphere of the ward-blocks. If a bath-room can be provided in this building for the use of the nurses and officers, it is very desirable, and would often tend to maintain their health and fitness for work. Lastly, the administrative block, being the building which first meets the view from the entrance, should offer a cheerful and pleasing appearance.

The next part of the hospital that demands attention is the accommodation for the patients. As has been already said, in a properly arranged hospital for various infectious fevers, the patients suffering under each form of disease must occupy a distinct building. It is moreover requisite in the case of each disease to provide for the due separation of the sexes. These conditions render it necessary to provide not less than two distinct blocks of building, well separated the one from the other, and not inconveniently distant from the administrative department.

It must be understood that these ward-blocks must be so disposed on the site as not to necessitate the traversing of one ward-block in order to gain access to another where a different kind of disease may be under treatment. But each ward-block should be so arranged relatively to the administrative block that it could be wholly independent of the other ward-blocks, and have no communication with the administrative block, except through the outer air.

Each ward-block should contain two wards—which could be used one for male and the other for female patients—and between the two wards it is convenient to place the nurse's duty-room or ward-scullery, also the entrance to the block and such other accommodation as is common to both wards.

In very complete hospitals, and where the number of beds necessitates the arrangement, it is useful to form a bath-room near the entrance, where a patient can be bathed. This is found exceedingly desirable, not so much perhaps during treatment as on his leaving the hospital, for the patient can here most conveniently perform the final cleansing process and change clothes before going back to his own home. In very small hospitals, where the wards are for only four or six beds each—these being rarely all occupied at one time—it is usual to have a movable bath on noiseless wheels for use in the wards. Indeed, such a bath is indispensable in each ward-block, whether there be a dis-

tinct bath-room or not, for in many cases the patient is more conveniently and safely bathed at his bedside than elsewhere, and by means of proper screens which, for various purposes, should always be at hand, an extemporised bath-room can be easily formed round the patient's bed. In that case special arrangements are requisite for emptying the bath and for charging it both with hot and with cold water, at the spot where the bath is usually kept. Where a fixed bath is used, one of glazed fire-clay—such as are made at Stourbridge—is perhaps the best kind, and it should be placed either in the middle of the bath-room or with one end only to the wall, so as to allow the nurses or attendants to have free access to both sides of the bath.

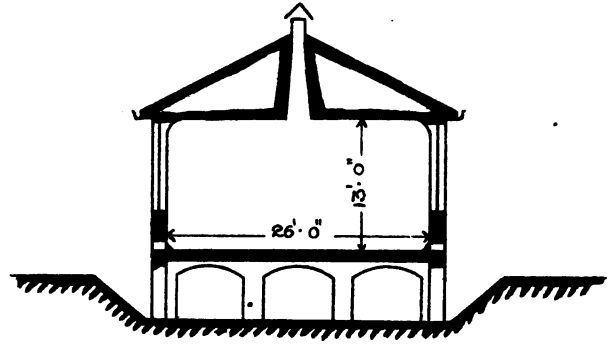
The nurse's room, or ward-scullery, in a well-arranged hospital should be regarded as her business-room. It should not contain a bed, for the reason that the nurse in charge should not sleep here; neither should it contain the easy chair, couch, or other such furniture that may sometimes be found in these rooms, for the nurse when on duty should be in the wards with her patients, except for the short time necessary in her business-room preparing something for them, and no encouragement should be afforded for her to remain in that room longer than necessary. It is, nevertheless, useful to provide an inspection-window from that room into each ward, and this window ought to have a fixed sash rather than one made to open.

The fittings of the nurse's business or duty-room will comprise a fireplace with small kitchener with oven and boiler, the latter being of sufficient capacity to supply ample hot water for baths, etc., unless there is a special general service of hot water. There should also be an ordinary scullery-sink, with water laid on for washing up food utensils, etc., and a dresser with shelves for the ordinary crockery, etc., used in the wards, and a good cupboard with glazed doors. An essential adjunct to this room, and one which is often omitted, is a small, cool and well ventilated pantry, where milk, beef-tea, and other articles of food can be kept during the night. In many instances I have observed much inconvenience from the absence of this important arrangement, resulting not unfrequently during hot weather in the spoiling of the entire quantity of milk and beef-tea supplied for the use of the patients during the night.

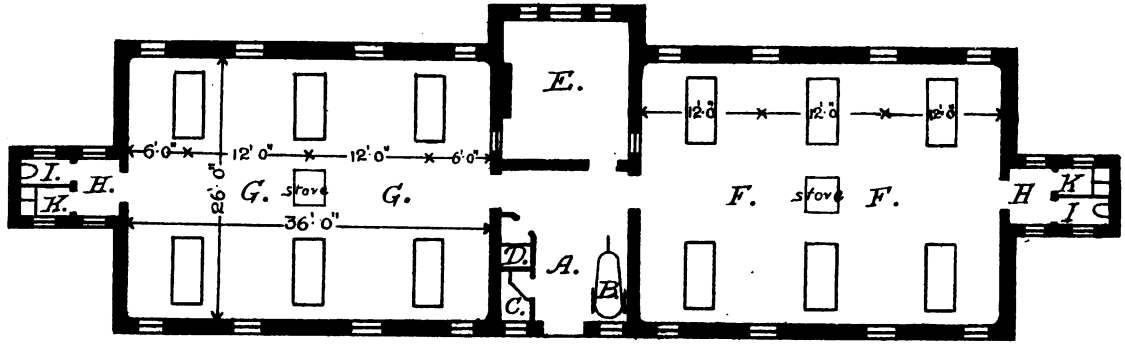
The wards themselves, being the chief feature of the hospital, call for the utmost care and consideration. Accepting the generally expressed opinion that each patient ought to have not less than 2,000 cubic feet of air space, and that

# Plan of One Ward Block.

A. Entrance.
B. Portable Bath.
C. Store.
D. Linen.
E. Ward Scullery.
F. F. Male Ward.
G. G. Female Ward.
H. H. Lobbies.
I. I. Water Closets.
K. K. Slop Sinks.




Section.




Plan.

it is essential that this amount should be made up with due regard to floor space and to distance apart of the beds, it has been usual to arrange the wards for two rows of beds, and to give a length of ward of 12 feet to each bed, and a floor-area of 144 square feet. The wards have accordingly been usually made 24 feet wide, 14 feet high, and of such a length as to give 12 feet of wall-space to each bed along both sides of the ward. These dimensions are usually considered to give about the most convenient shape for all purposes; the width allows ample space in the middle of the ward between the feet of the opposite rows of beds; and also allows the fireplace to be put there, in which position it gives the greatest amount of warmth to the ward, and can generally be seen by the largest number of patients. I am not sure, however, that slightly different dimensions might not be adopted with advantage; thus, instead of making the ward so high as 14 feet, it might sometimes be better to reduce it to 13 feet, and to increase the width to 26 feet. This would slightly increase the floor-area, while it would allow of the beds being placed a foot or more away from the walls, thereby tending to facilitate the free circulation of air about the head of the bed.*

With reference to the size of the wards, the width and height may be regarded as approximately fixed dimensions; but the length will depend on the number of beds intended to be placed in the ward. I have known wards for infectious fevers which measure 80 to 100 feet and even more in length, and in which may be seen scores of patients. My own opinion is that this is not a judicious arrangement, and that, in the infectious hospital of the future, we shall reduce the number of beds in any one ward far below the numbers I have just referred to. In certain recently built general hospitals on the Continent, it has been deemed desirable to restrict the number of patients in the surgical and acute medical wards to a maximum of about twenty under one roof, the wards being only one-storey high; and I cannot but think that in hospitals for infectious fevers, whatever may be the total number of beds to be provided, the number of patients in any one detached ward-block ought never to exceed that number, while it would be better to restrict the number to a maximum of twelve or sixteen patients.

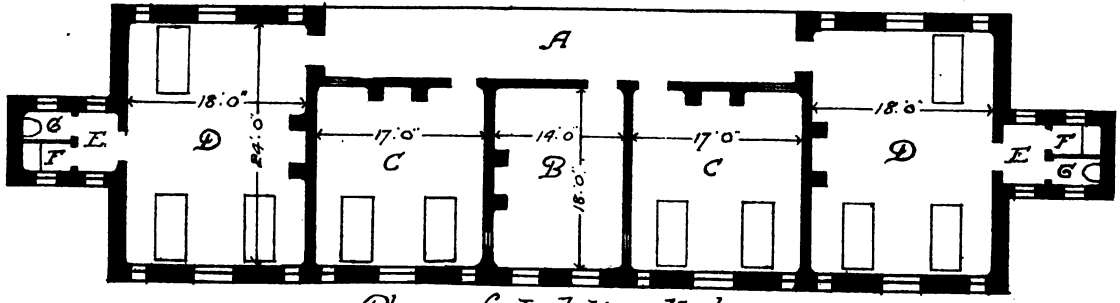
In connection with the question of the most desirable size for each ward-block in an infectious diseases hospital, is that of the expediency of placing the wards one above

* See accompanying plan and section of a ward-block.

another. There may be circumstances in which two or even three storeys of wards may be a necessity; but I am strongly of opinion that wards of the size I have ventured to recommend should, if possible, be in one-storey buildings only.

The objections to placing wards in more than one storey appear to me to be of two kinds, 1st, sanitary; and 2nd, administrative. As regards the objection on sanitary grounds to wards one above another, it will be admitted, I think, that the vitiated and infected atmosphere of the lower ward will be more likely to ascend into the upper ward or wards if means of access thereto are available. Thus, if a staircase lead directly from the lower to the upper wards, it will serve as an air-shaft from the lower to the upper storeys. Again, there will certainly be risk of the air which passes from the upper part of the ground-floor ward by the windows and ventilators being, under certain conditions of the atmosphere, at once drawn into the ward immediately above it at the windows or the ventilators near the floor. In support of this objection I venture to think that most medical men would hesitate to treat patients suffering from any ordinary complaint in a first-floor ward, while patients suffering from some infectious disease occupied the ground-floor ward immediately beneath.

I would also refer to the ordinary arrangement of a wash-house as a one-storey building, because, if it be beneath other storeys, the steam and smell escaping from its windows will undoubtedly get in at the windows of the rooms immediately over it. The same thing occurs in most of our London houses where the kitchen occupies the front basement, the dining-room being immediately above it. I have known in summer time, when the windows of the kitchen and dining-room were open, an unmistakeable passage by that channel of the smell of the cooking in the kitchen. No doubt, by special arrangement of the staircase, and likewise by special means of ventilation, it might be possible to lessen or altogether remove the objection just referred to. Not so, however, as regards the administrative objection. Two wards for six or eight beds each, might, under ordinary circumstances, be fairly well supervised by one qualified nurse if both of them were on the same floor; but the difficulty of efficient supervision would be very greatly increased if the two wards were on different floors. The labour of administering two wards would likewise be greatly increased by the use of a staircase of about twenty-six steps, necessary to ascend from the lower to the upper ward. Another point to be borne in mind in




Plan of Isolation Block

A. Entrance
B. Nurses Room
C. Small wards
D Large d°
E. Lobbies
F. Slop sinks
G. Water closets.

arranging a two-storey building is, that the increased height will necessitate somewhat increased distances between the several blocks of building. Otherwise the access of light and circulation of air about them can scarcely fail to be impaired. For all the foregoing reasons, therefore, I should strongly deprecate the formation of general ward-blocks of two or more storeys in height, unless it cannot possibly be avoided, and of course then only for the treatment of one and the same disease.

Before dismissing the subject of general arrangement of the wards of an infectious diseases hospital, I wish to refer very briefly to one or two special arrangements of wards that are often found most advantageous.

In every hospital it will be found extremely useful to have at least one small ward for one or two beds, placed so as to allow of the isolation for a day or two of a patient the precise nature of whose disease has not quite shown itself. It will readily be understood that this provision may sometimes prove of infinite value in preventing the introduction into an infected atmosphere of a patient whose complaint may, after twenty-four hours, prove to be no infectious disease at all, or in enabling the medical officer of the hospital to decide with certainty to which ward the newly received patient should be taken. Such a ward, moreover, readily admits of the reception of a patient desiring somewhat superior accommodation to that afforded by the general wards.*

Another arrangement of wards is sometimes found desirable in the case of a district resorted to by wealthy visitors for purposes of health. In order that every inducement to go to the hospital may be afforded to visitors who, during their stay in a district, may fall ill of some infectious disease, it is useful to have a few private rooms suitably fitted up and arranged for the reception of one or more members of a family, and provided with the necessary nurse's room, bath, w.c. and other requisite accommodation.

My friend Mr. Keith Young has kindly lent me plans which, in conjunction with Dr. Charles West, he prepared a short time since for a small infectious diseases hospital at Nice, entirely upon the principle of private rooms. In this instance a nurse's room is attached to each sick room, and a broad verandah gives access to the several rooms in such a way that there is no enclosed atmospheric communication from one sick-room to another, and, consequently, it would be

* An isolation block of four separate ward-rooms is shown at c in the block plan facing page 145, and a detail plan of the block is given opposite.

possible to treat different kinds of infection in the several rooms with reasonable immunity from danger of the spread of infection from one room to another. The verandah along one side of the rooms is arranged so that the patients, while still in bed, may, if desired, be easily removed from their rooms into the external air whenever the weather is sufficiently genial—an arrangement adopted in some of the most recently built hospitals on the Continent, and one which is spoken of as being very beneficial to the patients. The plans provide for the treatment of small-pox in a distinct and separate block of rooms. A block of private rooms, to serve as part of an infectious diseases hospital, has been erected at Folkestone by the Local Authority, where it has been found very useful.*

Referring now to a few matters of detail in the wards, I must mention that the windows ought to be of sufficient size without being in excess. If too much glass be provided in a ward, considerable difficulty will be experienced in maintaining an even temperature, while, in cold weather, the cost and difficulty of keeping the ward up to a requisite warmth is increased.

The chief points to be observed in arranging the windows are, that they shall adequately light and ventilate the ward without creating inconvenience to the patients. For these purposes it is usual to place the windows in the opposite side walls of the ward, and to arrange them so as to come between the beds. It is likewise very desirable to secure a window near each corner of the ward. The total quantity of window space in a ward is generally calculated according to the cubic contents of the ward, and Dr. Thorne Thorne has laid down a proportion of one square foot of window opening to about every seventy cubic feet contained in the ward as being, on the whole, the most advantageous. The windows should extend from about three feet above the floor to as near the ceiling level as possible, never being more than one foot below that level. As regards the kind of window to be adopted, the ordinary double hung sash window seems to afford greater facilities and convenience than any other for ventilating the ward at all seasons. It can without difficulty be adjusted so as to admit a constant current of air, either at the sill or at the head, or at the meeting bars, and it can likewise be opened wide at top *or* bottom, or at top *and* bottom, so as to flush the ward with fresh air. In the case of wards of considerable height, it is useful to divide the

* Since this paper was read, a very excellent detached block of isolation rooms has been erected, from the designs of Mr. Keith Young, at the London Fever Hospital, Islington.

windows into three portions, the lower two being the double-hung sashes just described, and the upper one being filled in with a sash hinged to a transome bar at its bottom, so as to open inwards. If this is not provided, the double-hung sashes alone are apt to be too large and cumbersome to be easily manipulated. Casement windows are useful sometimes to give easy access direct from a ward to a balcony or verandah; and where the latter is sufficiently broad to allow some of the beds, with the patients in them, to be wheeled out in fine weather, the casement window serves a really useful purpose. Unless it is made with great care, however, it is liable to be draughty and not weather-proof.

The floor of the wards is usually formed of wood; concrete, cement, and asphalte, however, have each been used, and it is possible that they each possess some advantages; but there can be little doubt that a wood floor is likely to be most generally preferred. The kind of floor which, on the whole, seems best adapted to the purpose consists of oak battens, in narrow widths. Good, hard, well-seasoned red deal also makes a not-unsatisfactory floor. In all cases the boards should be grooved and tongued, so as effectually to stop any openings at the joints, and the surface may usefully be polished with beeswax and turpentine.

The internal face of the walls should be formed of some hard non-absorbent surface, such as Parian cement. Glazed bricks are sometimes used with good effect, but the number of joints in such brickwork facilitates the accumulation of ward-dust. Good glazed bricks, however, set with fine joints in white lead, would answer the purpose satisfactorily; of course no cornices, mouldings, or projecting enrichments on which dust could lodge would be permissible; and I may here mention that advantage results from rounding all internal angles where ward-dust, etc., could otherwise accumulate. In the same way, an open roof, in which the exposed timbers allow dust to lodge, is less preferable than a flat ceiling.

The necessary arrangements for the disposal of excreta connected with each ward usually comprise a water or earth closet, and a slop-sink. These are placed in a projection from the end of the ward, and should be separated from the ward by an intervening lobby. Both the lobby and the closets should be provided with independent means of cross ventilation by opposite external windows. The cross-ventilated lobby is needed in order to prevent, in the most effectual way, the passage of foul air from the closets into the ward. It should be separated from the closets by a close partition extending

from floor to ceiling; the partition separating the water or earth closet from the sink-closet, however, ought to be a dwarf partition about six feet high, so as not to interfere with the cross-current of air between the opposite windows. The lobby should be no larger than is necessary to afford convenient access to the closets, otherwise it is apt to become a receptacle for various articles that ought to be kept elsewhere, or temporarily for soiled linen, etc., and it is better that no fittings of any kind should be fixed in it, its sole use being to protect the ward from the admission of foul air from the closets.

The water-closet should be fitted with the simplest form of valve or syphon-trap apparatus, the basin being of plain, white glazed earthenware, without ornamental pattern or advertisement upon it, and so that any dirt on its surface may readily be detected. A syphon-trap is perhaps preferable to a valve-closet, because it is simpler in mechanism, and can be supplied all in one piece of ware; and, moreover, it can be fixed with a hardwood seat and no other enclosure, thereby allowing the floor of the closet to be continued under the seat, and the whole space there to be visible and subject to the daily application of duster and broom. I have found closets fitted up in this way answer admirably, and they are far more easily kept clean than closets in which the seat is wholly enclosed, so as to hide any filth that gets accidentally spilt outside the basin.

The slop-sink should be fitted up in many respects like a water-closet, but with a good flushing-tap over it. If hot water can easily be supplied there as well as cold, so much the better. The hot water service-pipes can then be utilised in preventing the water in the other pipes and apparatus from freezing in very cold weather.

Before leaving the subject of the wards of a hospital, I am bound to say a few words upon the all-important question of ventilation and warming. I refer to the ventilation and warming together, because I believe it to be impossible to deal satisfactorily with the former without at the same time considering the latter. To have that effectual ventilation which is indispensable in the successful treatment of all sickness, and especially of infectious disease, it is necessary to provide, without possibility of failure, for the constant and uninterrupted renewal of ward-air from the exterior.

In our climate we have extremes of temperature; in summer, sometimes an almost tropical heat; in winter—though perhaps for only a short period—a cold equal to that which is commonly experienced in some of the north central

parts of Europe; and in many localities that low temperature is aggravated by a certain degree of moisture. So far as my observations go, we are quite unprepared, in the majority of our hospitals, to admit the requisite supply of fresh air, under these latter conditions at least, into the wards in such a way as to be without prejudice to the patients. I know instances where, in the coldest weather, it has been found impossible to maintain a temperature in enteric fever wards of more than 42 deg. Fahr., and this with the windows practically closed. I leave it to you, Gentlemen, to judge of the effect of such conditions on the patients. What I contend for is that, in the coldest weather, fresh air from the outside shall still be freely admitted into the wards, but that means of warming the air, adequate to the requirements of the severest weather, shall be also provided.

On the Continent, this is very generally done by means of *calorifères*, which supply hot fresh air to the wards from a chamber and heating apparatus outside, or beneath, the ward. It is very doubtful, however, whether this is altogether a desirable plan, as the air so supplied is always very dry, and is liable to be burned, or otherwise prejudicially affected before entering the ward. I am strongly of opinion that in our climate, and for the small hospitals under consideration, it is better to adopt powerful stoves, or grates, in the wards, and to supplement them, where necessary, by hot water pipes passing round the wards. For the admission of fresh air it is useful to provide short flues passing directly through the external walls of the ward at the floor level, one behind each bed, as being the least inconvenient and most advantageous position. Such openings may have a superficial area of one hundred square inches or more, and, if provided with a sliding shutter for occasionally closing them for a few minutes, they are not in practice found to be ordinarily inconvenient. Other openings may usefully be formed in the upper part of the opposite external walls, near the ceiling, and in this way the ward may be kept in constant communication with the external air. The hot-water pipes, if placed near the ventilating openings at the floor level, will perform good service in warming the fresh air as it enters the wards. But it is important to bear in mind that the pipes must be fixed at least four inches away from the floor and wall, in order to allow the space about them to be frequently and easily cleaned. If they are fixed close to the wall and floor, or in a channel beneath a grating in the floor, they allow a vast quantity of infected ward-dust, hair, cotton-fibre, and other matters to accumulate, which encourage vermin and tend to pollute the

air of the ward. Ventilating stoves are very useful in a ward, but they must not be relied upon for permanent ventilation, as they are only in active operation when a fire is alight in them; the air-chambers and flues, moreover, of ventilating stoves or grates ought always to be capable of being readily cleansed—a duty which should be regularly and frequently performed. If any kind of extracting ventilator is fixed in the roof above a flat ceiling, it ought to be directly connected with the interior of the ward by means of an enclosed vertical shaft. Horizontal trunks are exceedingly objectionable, as they allow of the deposit and accumulation of infected ward-dust, and are always difficult to clean.

In connection with the ventilation of the wards, I wish to refer again to the necessity for raising the floor-level of the wards well above the ground, and allowing a free current of air to pass beneath the wards. The small air-bricks usually inserted for the prevention of dry-rot in the floor joists are of very restricted use, whereas the large arched openings in the side walls and the clear space beneath the wards already recommended will effectually prevent the stagnation of air beneath and around the wards, while the ground beneath them, and for a short distance on either side, being covered with a layer of concrete, will not exhale damp and unwholesome ground-air in close proximity to the ventilators at the floor level of the wards. Hence I am disposed to attach much importance to keeping the ward-blocks well above the ground and to the provision of ample openings in the external walls below the floor-level. Even if this be not done, however, it is most important to cover the surface of the ground beneath the building with a layer of cement or lias concrete, in order to prevent the exhalation of moisture or ground air from the subsoil from entering the building.

The outbuildings of an infectious diseases hospital usually comprise a washhouse and laundry, a disinfecting-house, an ambulance-house, a mortuary, and a post-mortem room, together with fuel-stores and the like. The washhouse ought to be of adequate size for the maximum quantity of washing that may have to be done for the hospital. It should be light and airy, and have ample roof ventilation. The laundry ought to be large enough to hold a mangle besides the usual ironing-boards; and between the washhouse and laundry it is convenient to have a drying-closet, the fire of which may be arranged to heat the irons used in the laundry. A drying-closet will be found very useful, not only during wet seasons, but for drying linen with rapidity. Whenever possible, however, drying in the open air is much to be preferred. In

close proximity to the washhouse may be the disinfecting-chamber, which should, where practicable, be arranged with a place for receiving articles to be disinfected separate from the place where articles which have been disinfected are deposited. Having regard to the importance of effectual disinfection, it seems to me very false economy to cramp the arrangement of the chamber itself, or to adopt any but a thoroughly efficient apparatus. Better to burn the articles in a furnace than to imperfectly disinfect them, and at the same time, as often happens in an inefficient machine, to damage them so that they have to be replaced at considerable cost. The apparatus must be of sufficient capacity to deal effectually with bedding and mattresses, as well as every description of clothing, carpets, rugs, etc.

The ambulance-house and the mortuary should be placed in an unobtrusive position not inconveniently remote from the main entrance. The dead-house ought to be well ventilated and lighted from the top, and it is always well to construct it so that it can be thoroughly swilled down with water. It is convenient also to provide a suitable room adjoining the dead-house where a post-mortem examination can be made. A proper table, also a sink and water-supply, shelves, etc., should be provided in this room.

Before concluding, I think it right to say a few words on the subject of drainage. In doing so, however, I should observe that any remarks I may make are equally applicable to any building; in fact, the drainage of an infectious diseases hospital differs in no essential point from the drainage of any other building. It may be useful, nevertheless, for me to refer very briefly to two or three important particulars that call for attention in every system of drains, in the hope that those who may be connected with the erection of any hospital will use their best endeavours to secure the most efficient arrangement of the drains that is practicable under the circumstances. No doubt, if drains are properly laid, and furnished with all the requisite appurtenances, and the work is done as it ought to be, they will involve somewhat greater cost than if laid in the way commonly adopted until some few years since, when the entire arrangement was generally left to the ingenuity of the excavator and bricklayer, and the whole was covered up and got out of sight with the least possible delay and supervision. It is, however, very unwise economy to save money over drain-laying. Drains, to be permanently efficient and satisfactory, require the most careful consideration in every particular, for which purpose it is imperative that details, as well as general draw-

ings, should be prepared, showing not only the course of the drains, their gradient, size, depth, and so forth, but all the requisite arrangements for inspecting them and for flushing and ventilating them; and most of these details ought to be drawn to a large scale. The execution of the work must be constantly supervised in the most careful way by the foreman and clerk of works, and these officers, with the architect, must each be impressed with the importance of having the work thoroughly well done. It should, moreover, be clearly understood from the first by the contractor, and, indeed, by all concerned, that the drains, on completion, would be tested in lengths by plugging the lower end of each length, and then filling the length of drain with water. If the drain then failed to hold the full quantity of water for a specified time—say four or six hours—it would be evident that means of leakage existed, for which the contractor would be held responsible. The only other point that I will here refer to in regard to the drains, is that they should be laid in direct lines, with uniform gradients between the several points where a change of direction or of gradient occurs, and at each of these points means of access to the drain should be provided, either by a man-hole or a lamp-hole, so that the entire system of drains could be inspected with ease at any moment. If all these precautions were taken, we should hear little of the drains of a building—whether a private house or a hospital—being found defective, rendering necessary most inconvenient and often very offensive work in opening up drains, that so frequently results from bad work.

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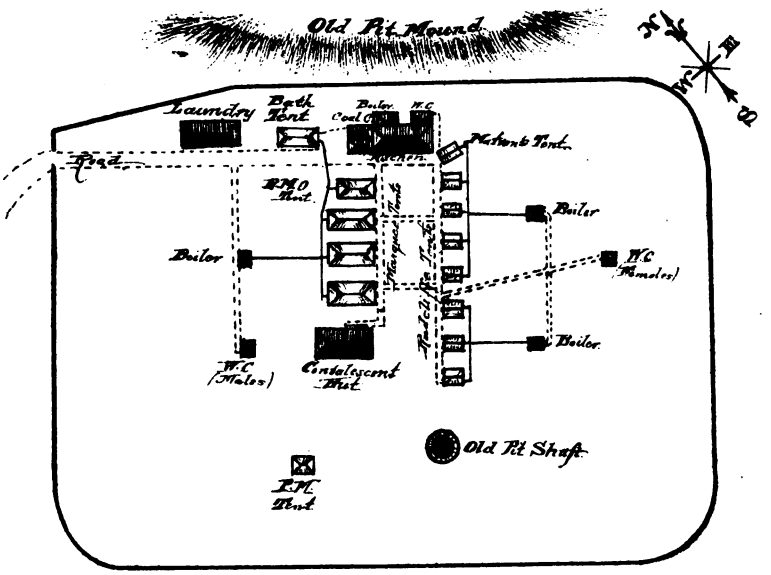
# Plan of Small-pox Hospital.

Wednesbury



# THE USE OF TENTS IN THE TREATMENT OF SMALL-POX.

By G. W. COLLINS, M.R.C.S.

(*Read: Jan. 3rd,* 1883.)

It is my purpose to lay before the Society the most prominent features in the arrangement of the Small-pox Tent Hospital under my charge at Wednesbury, Staffordshire, during the recent epidemic at that place, and to show, from my experience there, and at Finchley, where, in 1881, I superintended a similar hospital, the relative merits and demerits of the methods adopted for the accommodation of small-pox patients. In order that my remarks may be more easily followed, I will give a brief outline of the disposition of the Wednesbury camp and the general arrangement of the tents.

The camp was situated on a bleak hill, at a distance of about seven hundred yards from the outskirts of the town, partially sheltered from the north by a disused pit-mound, but very exposed to the east wind,—a circumstance that materially affected the temperature of some of the tents. Two kinds of tents were in use, viz., the Radcliffe hospital tent, and the hospital marquee. These were respectively pitched in two parallel lines, with a wooden hut for convalescent patients at one end, and the bath-tent, kitchen and laundry, two separate brick buildings, at the other. There was also a *post-mortem* tent attached to the camp, but, owing to popular prejudice, I was unable to make use of it. The whole camp was surrounded by a wooden hoarding seven feet high, which enclosed about two or three acres of ground. The plan which I have had prepared will more readily explain this to you. Of the twelve tents forming the encampment, eight were Radcliffe and three were hospital marquees; two of the Radcliffe tents being appropriated to the nurses and matron, and the remaining six to patients. There was also a Mildmay tent provided for myself.

The dimensions of the two kinds of tents were as follows:—

*Radcliffe,* 16 feet long, 14 feet wide, and 13 feet high to the ridge, containing 1,850 cubic feet of air, and 224 super-

ficial feet area, and holding four patients, giving 56 superficial feet to each patient.

*Hospital Marquee*, 30 feet long, 16 feet wide, 7 feet high at the sides, and about 11 feet high to the ridge, containing 3,800 cubic feet, 400 superficial feet area, and holding eight patients, giving 50 superficial feet to each patient.

The heating of the tents was performed by hot-water pipes running round each tent, supplied from three furnaces, two of which supplied the eight Radcliffe tents, and the other the three marquees. The bath-tent had a separate boiler and supply. Two systems of drainage were used. The sewage from the kitchen and laundry was conveyed to the common sewer of the town, and that from the wards was collected into two deep pits, sunk at opposite sides of the enclosure, and lined with brick, over which the closets were built. The porous nature of the soil readily absorbed the liquids of the drainage, and the deposit was daily covered with carbolised sawdust. This appeared to answer the requirements of the camp sufficiently well. All linen from the wards was soaked for twenty-four hours in carbolic acid to the strength of 1 in 50 before going to the laundry.

Having thus epitomised the arrangement of the camp, which in its organization and disposition was similar to the Small-pox Hospital at Finchley, sketches of which I likewise place before you, I come to the object of my paper, viz., that of discussing the various advantages and disadvantages of each kind of tent as adapted to small-pox, so far as my own experience goes. And I may say at once that I consider the Marquee greatly superior to the Radcliffe, both on account of the greater convenience which the larger tent affords, and also for its higher sanitary qualifications. This opinion, formed by my experience of both seasons of the year, during the summer at Finchley, and during the present winter at Wednesbury, I base on the following grounds.

From the figures I have quoted, it will be seen that the Marquee tent contains more than double the amount of cubic space (100 cubic feet more) than the Radcliffe. It is true that it holds double the number of patients, and this might *prima facie* seem to place them upon an equal footing, but the several advantages connected with the ventilation of the larger tent, will, I think, lead you to agree with me that the Marquee serves the purpose most adequately. In the first place, it is extremely difficult, if not impossible, under some circumstances, to maintain a sufficiently high temperature in a Radcliffe tent, whereas in the marquee this can be

accomplished with comparative ease. This is mainly due to the small size of the former tent and the absence of proper means of ventilation. Joined to this, in the smaller tent, a much greater volume of cold air is unavoidably allowed to enter with each opening of the door; and this volume of cold air is not only proportionately but practically larger than that which enters a Marquee from the same cause. When constantly repeated, as in attending confluent cases, which require frequent visiting, this disturbance will cause a reduction of as much as 15 deg. in the course of an hour. And as, in order to prevent the super-heating of the tent, it is necessary to keep the canvas more or less raised at the aperture of entrance—there being no other adequate means by which ventilation can be effected at will—the difficulties to be encountered in wet or snowy weather are sufficiently apparent.

It is but right to say that these tents, when empty, properly closed, and heated by hot water without gas, can be kept at a temperature varying from 50 deg. to 60 deg., but, when occupied, the temperature rapidly runs up to 75 deg., and they become unpleasantly warm. Wind also, when these tents are subject to its direct force from any particular quarter, sensibly affects them, owing to the manner in which the canvas is fastened at the entrance; and when the wind is accompanied by snow or rain, the inner and outer walls at the front and back are blown together, thus rendering the inner wall wet; both snow and rain, too, find their way to the inside of the tent, through the inadequate arrangement of the ventilators in the roof. It is, therefore, obvious that in wet or snowy weather a want of care on the part of the nurses in adjusting the canvas, and the goings in and out according to the necessities of the patients, combine to form a serious drawback.

Again, the small size of the Radcliffe tent renders it particularly unsuited for the reception of confluent cases, because the smell from only one such case quickly pervades the whole interior to a most objectionable degree, and when two bad cases lie together under one canvas, it becomes unbearable to both the nurses and the other patients for any length of time. When it is remembered that there is either insufficient or ill-regulated ventilation at hand to remedy this inconvenience, it becomes a factor assuming a prominence which entitles it to special notice and consideration. I may likewise mention that there is a large number of straps, six in all, to unbuckle and refix at each entrance or exit, and, not-

withstanding this precaution, the cold air from without still succeeds in forcing its way in.

As opposed to these disadvantages, the Marquee tent answers all the requirements that the Radcliffe in its present shape fails to accomplish. Its chief advantage is that an even temperature may be maintained day and night with a minimum of trouble, notwithstanding the variations of the external atmosphere. As a fair instance of this, I may state that a tent of this description, when unoccupied, was kept at 62 deg. Fahr., without gas, and by the hot-water apparatus alone, while the thermometer outside stood at 28 deg. Fahr., and this was effected without other trouble than that of keeping the furnaces properly charged. This regularity of temperature is to be accounted for by the presence of that method of ventilation which is absent in the previously considered type of tent, and the arrangement of the canvas at the entrance. Here the ventilation is perfect and under complete control. The cold air which finds its way in with the opening of the door is merely nominal, and, owing to the capacity of the structure, the effect of the small amount that does enter is entirely neutralised by the large volume of warm air with which it comes in contact.

In consequence of the admirable system of ventilation adopted in these tents, there is entire freedom from draughts, and the snow and rain never get in, either through the door—owing to the efficient overlapping of the canvas,—or through the ventilators in the roof—owing to their property of being closed at will from the inside; nor does the inner wall of the tent ever become wet, as is the case with the Radcliffe tent. In conjunction with the system of ventilation, the size of this form of tent prevents the unpleasant smell from the confluent cases being perceived, and it is only when the ventilators are kept closed, and the temperature is allowed to rise, that this inconvenience becomes perceptible.

The larger tent, containing as it does double the number of patients, as it were in one room, it is apparent that the necessary attendance is less divided, is centred more into one focus, and is consequently under more direct supervision—an item of as much importance to the patients as to the medical staff; so that it requires less trouble to attend eight patients in a Marquee than the same number in two Radcliffe tents. In fact, I found that two day nurses and one night nurse were sufficient for the twenty-four patients under three Marquees, where two day and two night nurses, for the same number of patients, had their attention divided over six

Radcliffe tents. The Marquee has also the advantage of greater comfort, and if the preference of the patients themselves be taken into account, it leaned invariably to the larger tent. The facility of ingress and egress likewise makes these tents preferable, for while allowing a speedy entrance or exit, the opening of the canvas is unaccompanied by a rush of cold air from without, on account of the suitable disposition of the canvas.

With reference to the hut attached to the camp at Wednesbury I have little to say. It was a four-sided wooden structure of a single floor, and was roofed with slates. It measured about 30 feet long, 20 feet wide, and 7 feet high at the sides, being divided by a transverse partition which separated the male and female patients, and contained twelve beds. It was used exclusively for convalescents. The heating was performed by means of a large stove in the centre, burning coals, and two ventilators were fitted to the roof, and one at each end of the building. This arrangement left much to be desired in the maintenance of an even temperature, for despite the greatest care draughts were frequent, and only with much difficulty could the temperature be prevented from undergoing variations corresponding to those of the external atmosphere. The comfort also of this building, although furnished in precisely the same style as the tents, was greatly inferior to that of the canvas structures.

As regards pulmonary complications, all of those which came under my notice were due to the effects of the disease itself, and none could be attributed to exposure to the cold air either in the Radcliffe or Marquee tents.

To sum up, then, the conclusions I have arrived at. The Radcliffe tent as at present constructed is not, in my opinion, so well adapted to the accommodation of small-pox patients as the Marquee, nor in fact to any disease characterised in some of its forms by powerful smells; but with suitable alterations in the mode of ventilation it would doubtless be eminently successful as a general hospital tent. The wooden hut I consider a still less appropriate form of lodgment, it being neither compact, commodious, nor so serviceable as a tent. The Marquee, on the other hand, is, owing to its efficient ventilation, admirably suited to the treatment of this disease, both in winter and summer. In winter the temperature can easily be preserved from the influence of the weather outside, so long as the heating apparatus is properly attended to; and in summer—even in very hot weather, as some of the days in the year before last, when the temperature was 105 deg. in the sun—perfect ventilation may be secured by opening both extremities of the tent, and looping up the sides.

Three important points I should like to impress are these. 1. All tents should have a trench surrounding them. 2. The floors should in every instance be raised a foot or more above the ground. 3. The canvas walls should not be pegged down to the ground, but fastened by ropes so that they may be looped up at the sides.

For the following digest of weather reports since September I am indebted to the courtesy of Mr. Symonds, F.R.S., and Mr. Marriott, both of the Meteorological Society; and I think it will serve to show very conclusively that tent hospitals can be successfully conducted under the most disadvantageous atmospherical influences.

The temperature varied considerably during my stay at Wednesbury, the two extremes being 66.8 deg. and 17.4 deg. Fahr. The highest mean was 46 deg.; the lowest mean was 33 deg. On fourteen days the temperature was above 60 deg., and on twenty-three days the temperature was below 32 deg.

During the ninety-eight days of my residence we had only nineteen days of sunshine. Of snow we had nine days; fog and rain, sixteen days; rain alone, forty-two days; and frost, twenty-three days. In spite of this continual variation, I found the Marquee tents capable of having their even temperatures maintained with very little more trouble than that required during the summer months at Finchley.

An abstract of the statistics obtained during the recent epidemic gives us the following figures, which may perhaps be interesting. Of the 118 patients treated during three and a half months, thirteen died, giving a mortality of 11 per cent. Ten of these succumbed to the severity of the disease; two died from pneumonia; one died from facial erysipelas; five cases had slight bronchitis on admission, and all the confluent cases had symptoms of the rash in the trachea and larynx. Twenty-four unvaccinated patients were admitted, and amongst these there was a mortality of nearly 21 per cent. (20.83 actually), the death-rate of the vaccinated patients being 7½ per cent. In eleven vaccinated cases the rash aborted either entirely or in part.

The following is a Table of the cases admitted :—

| | Male. | Female. | Total. |
|---|---|---|---|
| Confluent | 18 | 20 | 38 |
| Semi-confluent | 7 | 11 | 18 |
| Discrete | 32 | 29 | 61 |
| Hæmorrhagic | 1 | — | 1 |
| | | | 118 |

*The Ordinary Meetings of the Society are held at*

## 11, CHANDOS STREET, CAVENDISH SQUARE,

ON THE SECOND WEDNESDAY OF EACH MONTH FROM NOVEMBER TO JULY INCLUSIVE, UNLESS OTHERWISE ANNOUNCED.

THE CHAIR IS TAKEN AT EIGHT O'CLOCK P.M. PRECISELY.

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*The Transactions for the Sessions* 1859-60, 1866-67, *and* 1867-68 *are out of print. With these exceptions, those for the Sessions from* 1860-61 *to the last Session inclusive, may be obtained from the publisher,* Mr. David Bogue, 3, St. Martin's Place, Trafalgar Square. *Prior to* 1859-60, *the Transactions were published in the* "Sanitary Review." *The issue of a new series of the Transactions was begun in* 1882.

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